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THE CIVIL SERVICE IN A DEMOCRACY

IN his picture of the administrative staff of the Civil Service which he gave in his Rede Lecture under the title "Portrait of a Profession", Sir Edward Bridges deliberately excluded, for reasons of time, the professional and technical staff in pursuit of their own specialized duties. Nevertheless, his account of the Civil Service tradition is of much interest to scientific men as well as to professional workers generally, whether or not they have been drawn within the ambit of the Civil Service itself, the public corporations or the nationalized industries. Sir Edward's exposition of the distinctive elements in the Civil Service tradition should contribute to a clearer understanding of the human side of the profession and make for more discerning criticism. Although he says little or nothing about the outstanding qualities or virtues of the Civil Service, which in Britain we are too apt to take for granted, some of them are admirably illustrated in the lecture itself. The historical survey of the development of the Civil Service and its tradition, for example, could scarcely be bettered as an example of the capacity of the Civil Service for good writing, to which Sir Hubert Henderson referred at the Conference on Industry and the Universities held at Ashorne Hill last November.

The question is implicit in that comment whether such a standard can be maintained indefinitely if the universities or the schools neglect to inculcate the ability to express ideas clearly in speech or writing; and we might well ask further whether we can continue to take for granted such acknowledged and conspicuous virtues as incorruptibility, political impartiality and laborious devotion to duty, and not take fuller account of those factors in political or social life, or in what is sometimes termed the climate of opinion, which tend to make their maintenance more difficult. The Prime Minister, in a recent statement regarding the size of the Civil Service, rightly deplored "the fashion now current in some quarters of speaking slightingly of the Civil Service as though its members were less useful members of the community than other people". We might also take note of those factors to which Mr. Maude and Mr. Lewis directed attention in their study of "The English Middle Classes" last year, which make increasingly difficult the maintenance of the cultural and intellectual background and the moral standards in which the Civil Service tradition is most easily nurtured.

The importance of such matters is unmistakable as we follow Sir Edward Bridges through his review of the developing characteristics of the Civil Service, and especially of what he describes as the storehouses of departmental experience. Although the non-political character of the Civil Service received its main imprint in the eighteenth century, the Civil Service as it exists to-day really starts from the reforms instituted by Stafford Northcote and Charles Trevelyan in the middle of the nineteenth century. In the twentieth century the allegiance or affinity

of the higher Civil servants to the views of particular ministers has diminished, and their attachment or loyalty to the Service increased; but Sir Edward suggests that the better organisation of the Service during the last hundred years has shown itself most markedly in the greater capacity of the staffs of departments to marshal previous experience and bring it to bear on current problems.

By degrees there has been built up in every department a store of knowledge and experience in the subjects handled, something which may eventually take shape as a practical philosophy, or may merit the title of a departmental point of view. Usually it is the result of nothing more startling than the slow accumulation of experience over the years, and Sir Edward's lecture would be worth reading for this interpretation of such departmental philosophies alone. They express the long continuity of experience which can be one of the strongest qualities of an institution, if well organised. They are broadly based and they are an inheritance which every Civil servant going to a new job ignores at his peril, but which it is his business to extend and improve in his turn.

These storehouses of departmental experience have a bearing on the relationship between day-to-day administration and policy, and Sir Edward's observations in this connexion deserve to be noted in the current discussion on the organisation and staffing of the public corporations or boards, as well as in that on the power of the Cabinet which arose out of Viscount Cecil of Chelwood's motion in the House of Lords on May 17. Sir Edward points out that administration and policy cannot be entirely separated, and decisions in one field cannot be taken independently of the other. It is a cardinal principle of British administration, he reminds us, that no attempt should be made to formulate a new policy in any matter without the fullest consultation with those who have practical experience in that field, and with those who will be called upon to execute the policy.

Ministers are rightly more interested in issues of policy than in detailed administration, but this does not mean that their advisers have no part to play in framing policy. Sir Edward observes that on those broad issues it is the duty of a Civil servant to give his Minister of State the fullest benefit of the storehouse of departmental experience and to contribute the practical knowledge which a Minister can rarely possess. Moreover, he points out that much more could be said about the application of this principle to modern large-scale organisations. With the middle ranks of such large organisations rests the responsibility for ensuring that whatever the head propounds is thoroughly understood by the hands, and that the hands which execute can communicate back to the head. At this middle level, indeed, policy and administration merge and are only distinguished with difficulty.

By this kind of process, writes Sir Edward, administration can be kept in tune with public opinion and the needs of the country. It would not be difficult, however, for an impartial critic to point to instances of distinct hiatus between ministers, if not departments, and public opinion or public needs, and much more might have been added on this point. Sir Edward himself is confident that the departments themselves are working together much more closely, that the fragmentary character of which Stafford Northcote and Trevelyan spoke is passing with the widening of experience. He believes that the growing practice of transfer from one job to another, whether within the same department or between departments, encourages the inter departmental discussion and co-operation at early stages which the exigencies of economic factors in recent years have compelled. He claims firmly that those who work in Whitehall to-day look over and beyond the boundaries of their departmental loyalties, and see themselves as part of a much larger and more complicated organisation, in which their own job can only be properly done if it takes its place in the fulfilment of the whole.

That is well said, but must not be emphasized to the neglect of the liaison between the executive and the public at large. It cannot be maintained that the introduction of public relations officers and all the paraphernalia of government publicity has yet established ideal relations between the administration and the ordinary citizen, or that the flow of information and understanding from the citizen to the government is any more satisfactory than the flow in the reverse direction. In the concluding part of his lecture, Sir Edward Bridges discusses some of the defects of the Civil servant; but neither there nor in his admirable summary of a Civil servant's job does he quite bring out what is wanted here. The coldly judicial attitude which the Civil servant has to combine with the warmer qualities essential to managing large staffs requires to be inspired also by imagination and a capacity to think himself into the place of the average citizen whose servant he is in reality. It is not just absence of direct responsibility which makes the average Civil servant uncomfortable and infelicitous in his relations with the Press; and one of the greatest needs of our time is a mutual understanding between the citizen and the administrator. This point was well emphasized in the concluding chapter of Mr. H. R. G. Greaves's "The Civil Service in the Changing State".

Sir Edward Bridges's lecture is a fitting complement to the debate initiated by Lord Cecil in the House of Lords, which brought out the importance of understanding the citizen's needs and point of view by the official or the Minister. Although Lord Cecil was concerned primarily with the power of the Cabinet, this is the real issue. The tendency to undervalue personal freedom and to substitute the group for the individual is unconscious rather than deliberate, arising from the diminished sense of personal responsibility and the failure to appreciate the vital importance of securing the interest and understanding of all concerned in any democratic undertaking. Lord Cecil argued that the growing power of the Cabinet and the fresh powers continuously given to the executive, the disappearance of the independent member of Parliament, and the inability of the House of Commons to control effectively the Cabinet, are endangering the whole fabric of Parliamentary

government by undermining the interest in and respect of the electorate for Parliament.

The Lord Chancellor, while maintaining that the Cabinet has for the past half-century or more occupied substantially the position it occupies to-day, agreed that the danger to which Lord Cecil had directed attention is real; but he does not think it would be a service to democracy to deprive the Cabinet of its present powers. The real danger to our system of democracy and to freedom lies, he believes, in the possibility that it might not be prompt and swift in action. Lord Simon emphasized more particularly the dangers which follow from the tendency towards increased submission of the ordinary member of Parliament to party leaders and to the enormously increased power in recent years of ministers and departments to guide our affairs by making regulations authorized by a general Act. This practice of delegated legislation gives ministers a power vastly in excess of anything known in previous Parliamentary democratic government in Britain—a power, in effect, to make laws without further effective reference to Parliament at all.

It is the necessity for perpetuating the Emergency Powers Act in this way that Lord Simon challenged; but no speaker put the real dilemma before the House better than the Bishop of Southwell in a speech which recalled some of the argument in Lord Lindsay of Birker's Terry Lectures on "Religion, Science and Society in the Modern World", which stressed the part of the free associations like the universities and the churches in integrating the life of the community. The real question, said the Bishop of Southwell in this maiden speech, is how a strong government, which the dangers facing democratic freedom everywhere necessitate, can avoid overwhelming the liberties which it is trying to defend or demoralizing the community which it is seeking to serve. It is a question not of the power of the Cabinet but of the ever-growing power of the State itself and its mounting claim to omniscience or infallibility. The real problem that democracy has to solve is how to maintain a strong and effective government in being, and simultaneously to preserve the critical independence, virility and initiative of the community on which it rests. Like Lord Lindsay, the Bishop of Southwell suggested that the really effective bulwark against centralized power is the vigour and jealous independence of all those many subordinate societies—clubs, associations of all kinds, professional guilds, trade organisations, cultural foundations, and above all the family—which make up the community on which the State is to rest. A democratic State should take every possible step to stimulate and strengthen these subordinate communities, not forgetting the traditional independence of local authorities. Above all, it is a question of men and women and their status; freedom, in tradition and experience, had always depended in Britain upon a religious valuation of men and women. It has yet to be seen, he said, whether freedom can survive, in any but a formal sense, on any other basis.

That view was strongly supported by the Duke of Montrose and the Marquess of Salisbury. The latter in particular, after urging that it is vital that the authority of both Houses of Parliament should be maintained *vis-à-vis* the Cabinet and the executive if a balance of liberty and authority—which is the basis of ordered freedom—is to survive, referred to the indispensable role of local representative institutions. These, however, are becoming more and more not agencies of local self-government but mere decentralized agents of the central government.

While Lord Addison, who replied, recognized the need of vigilance to safeguard our liberties in respect of departmental and other administrative arrangements, he did not admit the danger of the growing power of the Cabinet. He claimed that Cabinets of to-day are more sensitive to public opinion than ever before; but on the issue of local democracy he made no comment. It is here, however, that the real issue lies, and the Bill for the Better Preservation of the Liberties of the Subject which Lord Samuel afterwards introduced, although purporting to provide a remedy for certain specific abuses or to restore specific liberties, gives Parliament a chance to restate a principle, now largely obscured, that links this whole discussion with the portrait of the Civil Service which Sir Edward Bridges has sketched. Lord Samuel takes the view that although the right of entry into buildings or to suppress or suspend periodicals may not often be abused, the existence of such powers tends to corrupt the proper relationship of the minor official with those whose servant he should be. The clause with regard to public local inquiries should go far to remove some of the friction and bitterness which have attended proposals regarding the acquisition of land for the Services or other public purposes, and it is indefensible that powers to inflict arbitrary fines should be possessed by tribunals which certainly have little resemblance to a court of law.

Some of the other clauses of Lord Samuel's bill may be debatable; but there are enough for Parliament to approve and, in so doing, to restate the principle that no man should be a judge of his own cause, and that accordingly the purpose of laws and regulations is not to make easier the performance by Civil servants of the tasks they have to a large extent set for themselves. If with that it be remembered that the first task of the legislator is to dig deep the channels of assent, it would often be found that the work of digging would establish a contact and understanding between the executive and the public which would make the proposed legislation largely unnecessary. Furthermore, a real effort on the part of the government to promote full and effective public discussion would have other advantages besides providing the basis for building an effective and intelligent public opinion while policy is being formed. It would contribute largely to independent expert discussion and the closer association and the fuller use of the scientific and technical expert in the task of government. With this might go the closer association of those independent groups, from the local government authority downwards, the place of which in active democracy has been under investigation by Political and Economic Planning and

was well stressed in the House of Lords debate. Finally, it would help in the linking up of the life of the Civil servant with some of the wide issues of the national life to which Sir Edward Bridges referred as providing one of the abiding satisfactions that offset the disappointments and frustrations inevitable in such a profession.

RADIATIVE TRANSFER IN TERMS OF INTEGRAL EQUATIONS

Radiative Transfer

By Prof. S. Chandrasekhar. (International Series of Monographs on Physics.) Pp. xiv+394. (Oxford: Clarendon Press; London: Oxford University Press, 1950.) 35*s*. net.

THE purpose of this book is, according to the preface, to present the subject of radiative equilibrium in plane-parallel atmospheres as a branch of mathematical physics, according to a new method involving the use of non-linear integral equations.

Integral equations have had a somewhat chequered career in mathematical physics. At first the hope was raised that the use of such equations might mean a great strategical advantage in the attack on various formidable mathematical problems presented by Nature. The theory of tides may be a good example (Poincaré), and most of the simpler oscillation problems of hydrodynamics are in the same category. Thus far, however, the differential equations seem to have held their position intact. But, within the special region of radiative transfer problems, the integral equations do provide a competitive way of approach, though even here it may be premature to proclaim the final victory.

It seems that integral equations were first introduced into radiation problems by Hilbert (1912) in a novel proof of Kirchhoff's law. Hilbert even maintained that the integral equations provided the only possible method of proving this law. The following year, L. V. King, in a paper on the Rayleigh scattering of sunlight in the terrestrial atmosphere, showed how the problem could be reduced to the solution of an ordinary linear integral equation of the Fredholm type. Another year after that (1914), K. Schwarzschild showed that the problem of the radiative equilibrium of an atmosphere leads to a Fredholm equation, and Milne, ten years later, extended Schwarzschild's work by showing how different transfer problems all lead to similar types of integral equations. So the matter grew step by step, and in 1934 E. Hopf collected and condensed the available contributions into a neat little book, exceedingly well written, and published as Cambridge Mathematical Tract No. 31.

The present book, which is five times the size of that of Hopf, carries the matter further in various ways. First of all, several introductory chapters are devoted to a careful definition of fundamental terms. The equation of transfer is derived for various representative cases like that of a purely scattering atmosphere with a conservative or non-conservative flux. Diffuse reflexion is considered, and it is shown how to handle problems in which the polarization of the light beam is important. The scattering power of the atmosphere may be either isotropic or anisotropic according to some given law, for example, that of Rayleigh.

Having in this way, so to speak, cleared the deck for action, the next chapters (4–8) are devoted to the development of the method of obtaining solutions by the use of non-linear integral equations. The lack of linearity does not seem to introduce any complications, as the equations may be handled essentially in the Fredholm way by replacing the integrals by a set of ordinary linear equations. The next solution is obtained by passing to the limit of an infinite number of equations, but it appears that in practice one may go a long way with quite a small number of steps. In fact, the original procedure of Schuster of replacing the radiation field by an outgoing and an ingoing stream is, in a certain sense, equivalent to replacing an integral equation by two ordinary linear equations.

Much emphasis is placed on certain novel principles of invariance, which were first formulated by the Soviet astronomer Ambarzumian. Chapter 4 is largely devoted to the discussion of these principles, to which the author concedes such great importance that he says in the preface that "the employment of certain general principles of invariance . . . has been my justification for writing this book". It seems, however, that these principles do not replace completely the physical considerations usually made in the theory of radiative transfer. In some cases, appeal must be made to supplementary considerations in order to make the solution unique (see §§ 61 and 62.2).

The subsequent chapters (9–12) are all in the nature of applications of the general theory as developed in preceding chapters. Chapter 9 is concerned with the problem of diffuse reflexion and transmission, Chapter 10 with planetary atmospheres, and Chapters 11 and 12 contain applications to stellar problems.

The book was planned as a mathematical work on non-linear integral equations, and the author has faithfully stuck to his programme. The inclusion of the two chapters on stellar problems seems to embarrass the author slightly. In fact, in the preface it is suggested that his view was biased in this matter by his astrophysical profession. Considering the fact that the majority of prospective buyers and readers of this book will be astrophysicists, this would seem to be carrying adherence to principles too far.

It will be interesting to watch further developments and to see how far this book will blaze a new trail for the use of integral equations in theoretical physics. Perhaps the change-over from linear to non-linear integral equations, by Laplace transforms or otherwise, may provide a practical way of handling oscillation problems hitherto considered intractable. The fact that the present book establishes a temporary ascendancy of integral equations in radiation theory should act as a strong encouragement for investigations along the same line in other fields. On the other hand, considering the still rather forbidding mathematical formalism required for the presentation of radiation theory in the new way, proponents of other methods of approach have no reason for being discouraged as yet.

The book is written with great care and should not be difficult for the reader, provided he has some taste for mathematical formalism. Inherently abstruse mathematics is generally avoided. The printing is very well done, and misprints are scarce. The author is to be heartily congratulated for having produced a work of high scientific standing, which at the same time has a distinctly personal flavour.

SVEIN ROSSELAND

PHYSICAL METHODS IN BIOLOGICAL RESEARCH

Biophysical Research Methods

Prepared by a Group of Specialists under the Editorship of Fred M. Uber. Pp. xi+667. (New York and London: Interscience Publishers, Inc., 1950.) 76*s*.

THERE are few, if any, volumes dealing with the research methods of biophysics. This American contribution to the subject is addressed in the preface to scientific workers who must resort to physical methods of research for the solution of biological problems, as well as to advanced students. This at once brings us to a contentious point: Should the word 'biophysics' connote chiefly the application of physical methods to biological research? Is it not rather the study of the physical relationships governing the behaviour of living material, which can be a very different subject, even though some of the techniques involved may be common to both interpretations? For example, the technique of measurement of isotopes is a biophysical research method when applied to the measurement of cell permeability; but when used for following a biochemical reaction there is no justification for calling the operation biophysics. A proportion of the volume is devoted to X-rays and ionizing radiation, which are certainly not methods for the study of the normal physical relationships of biological material, however interesting and important may be the effects of ionization on the genes. In short, then, it is suggested that a better title might be "Physical Methods in Biological Research", and the work will have to be criticized from this point of view. The purely physical approach is shown by the fact that it contains no description of biological techniques.

As is inevitable in a compendium written by a number of authors, the degree of thoroughness of treatment of the respective subjects varies very greatly, and there are several gaps or omissions. Thus, one is told in considerable detail, resembling that of the school physics text-book, about scales of temperature, calibration of thermometers, how to set a Beckmann thermometer, and how to connect up a thermocouple in several different ways; but there is nothing whatever about the measurement of diffusion, refractive index, dielectric constant, *p*H, particle dimensions, methods of mechanical recording, X-ray and electron diffraction, surface films, or stimulators. It may be argued in favour of the editor that these subjects are very specialized, but surely no more so than ultrasonic generators or the electron microscope, which do find a place in the book.

The first chapter, entitled "Avoid Fruitless Experiments", contains excellent advice for the beginner in biological research; and the remarks on the values of co-operation in those researches which require complicated equipment could well be taken to heart by some directors of research in universities who, perhaps by reason of research-degree regulations, still tend to discourage joint work.

The chapters all include bibliographies. Those on "Centrifugation" and "Electrons, Neutrons and α-Particles" have the most useful collections, the other chapters often omitting key references, which is regrettable. The descriptions of the methods of measurement are not sufficiently detailed to make the volume more than an introduction to a separate treatise on the individual subject in question, where one exists. It is interesting to see how the various contributors have introduced their pet topics into the text; for example, following the chapter on temperature determination, there are three pages concerning the temperature coefficients of biological reactions and the theories to account for these, which are quite irrelevant. The chapter on calorimetry covers such a variety of topics as the heat production of nerves and of animals, including man, and the use of the bomb calorimeter.

On "Osmotic Pressure Measurements" no mention is made of the osmotic balance of Svedberg or the work of Fuoss. A useful chapter on freeze-drying includes much information on the preservation of viruses and bacteria; but it is a pity that more figures are not available for the conditions of time and temperature required for the treatment of tissue samples. It is a little surprising that the chapter on viscosity does not include any mention of the common methods of determination, namely, the Ostwald tube, the flow method, and the dynamic methods. Some mention might have been made of Perrin's classical work when describing the Brownian movement method. The point made in the same chapter that intact cells rather than extracts should be the subject of study is important and, indeed, may serve to distinguish biophysics from physical biochemistry.

"Bioelectric Measurements" only occupies 38 out of 655 pages and deserves more space. The discussion of electrode potentials in terms of solution pressure is rather dated and would better be put in terms of work function and energy of hydration of the ions (see, for example, Gurney's "Ions in Solution"). More detail and references concerning electrometer amplifiers and direct-coupled amplifiers would be useful; papers by Nielsen, Artzt, Miller and Goldberg should be quoted to provide sources of information on these subjects. A circuit is given for a stabilized power-supply where reference to a published circuit of proved performance would suffice. Only one short paragraph discusses oscilloscopes, and it states that most of them are capacity coupled. This may be true in the United States, but a number of direct-coupled instruments are available in Great Britain, which, perhaps with the addition of a high-impedance input stage, are suitable for laboratory applications. More could be said about the recording of bioelectric phenomena, including such topics as synchronizing the time base of an oscilloscope with a stimulus, and the photography of cathode-ray tube traces.

The chapters on centrifugation and electrophoresis are useful, as is the one on the use of special microscopes. The part dealing with the electron microscope and what can be done with it includes guidance on the organisation of a research requiring use of the instrument. Infra-red and ultra-violet techniques are not mentioned, and indeed there is no description of the ordinary spectrometer. This omission may be justified, but it is peculiar if compared with the fairly detailed description of the microscope in an early chapter and of radiation-dose meters in the following chapters.

It is particularly difficult to review the parts on "X-rays" and "Electrons, Neutrons and Alpha Particles" on account of the specialization in this field. The specimen results for the genetic effects of radiation have a proper insistence on the statistical nature of the process. The latter of the two chapters contains a rather complete description of methods of measurement of ionization produced by various particles as well as numerical data for their ranges in

tissue, and an extensive bibliography. It is, accordingly, more potentially useful as a source of reference than the other sections. The discussion of the application of stable isotopes includes descriptions of the mass spectrometer, but not of the densimetric method for the analysis of deuterium and oxygen-18, being content with reference to another work.

The subject of radioactive tracers has been dealt with in several volumes recently, and it is obvious that in fifty pages only limited information may be given. The Lauritsen electroscope is described at some length. There is the almost inevitable sketch of a bell-type Geiger–Müller counter, but no mention of counters for liquid samples, which are of common occurrence in biological work. Nothing is said of the correction which has to be made for dead time of the counting equipment, although other corrections are discussed. Mention might be made of the application of radioactive tracers in chromatography.

In conclusion, I feel that this book should be useful to the student of M.Sc. standard, who wants an introductory survey of some of the physical methods of attacking problems. It is not, nor does it claim to be, a book of reference for practical laboratory work.

E. J. HARRIS

SELECTION OF LEADERS IN WAR-TIME

The Group Approach to Leadership-Testing

By Dr. Henry Harris. Pp. x+288. (London: Routledge and Kegan Paul, Ltd., 1949.) 21*s*. net.

IT is well known that during the Second World War the British Army developed a somewhat elaborate procedure for the selection by special boards of potential officers. In this book Dr. Henry Harris gives a reasonably full and detailed account of the practices that were adopted and of how and why they were used.

It is interesting and possibly significant that the account begins by a discussion of 'theories'. Maybe this is merely a matter of convenience in exposition; but it is hard to escape from the impression that, first, a general and very speculative view of personality and group functions and relations was accepted (mainly in terms of the 'field theory' of Lewin and others, with a strong mixture of general psychiatry, perhaps largely of a Freudian type) and then all sorts of ingenious ways of illustrating this view in concrete situations were organised and applied. If this is what happened, nobody has any right to complain, for the conditions were urgent and the time short. But the basic problem of how to find sectional leaders remains as important in peace as in war, and, if it is implied that the procedure adopted should remain a model for all subsequent approach, difficulties are bound to arise.

Obviously the justification of any selection procedure must rest mainly upon validation. A chapter on validation of the War Office Selection Board methods, written by Major Gavin Reeve, is included in this book; but it is not satisfactory. It does show that the verdicts reached were, by the accepted statistical criteria, reasonably reliable; but that is not enough, especially in view of the very uniform training given to the essential officers of the selection boards. It shows also that training wastage was substantially reduced, and this, in the circumstances, is a great and important point in favour of the general scheme. But it does not, and indeed cannot, show whether the leaders selected were in later trial significantly better than those picked out in any other way. That this is a critically difficult task anybody with experience, even in much more defined fields of personnel selection, will at once agree; but it is a task that must be attempted when there is time, for it will certainly never be accomplished in an atmosphere of crisis.

On a descriptive level, the book is extremely interesting and well written. It reveals a carefully planned and conducted effort which deserves all the praise—and perhaps some of the blame—which it has received. Very appreciative comments by Sir Ronald Adam and Brigadier Torrie are included, and these two are, beyond doubt, among those who should know.

F. C. BARTLETT

ARCHÆOLOGY OF THE BADEGOULE SITE

Badegoule, Station solutréenne et proto-magdalénienne

Par Dr. André Cheynier. (Archives de l'Institut de Paléontologie humaine, Mémoire 23.) Pp. iii+230. (Paris: Masson et Cie., 1949.) 2500 francs.

THE prehistoric site at Badegoule has been known for a long time. Indeed, so long ago as 1906 it was described by Drs. Paul Girod and Massénat, and a section given. These investigators realized that here was an important Solutrean station worthy to be classed with Laugerie Haute. M. Peyrony dug there, and an account of his finds appeared in the *Revue Préhistorique* for 1908. Hauser and the Abbé Bouyssonie also examined the place; but for the period 1928–39 the site was systematically studied by Dr. André Cheynier, who, as a local medical practitioner, was able to give it his continuous attention.

At the base there is evidence of sporadic occupation by Mousterian folk, though the rarity of the finds and the absence of hearths has led Dr. Cheynier to the conclusion that the Mousterians never made the place into a real home. But the importance of Badegoule lies in the extensive Solutrean layers occurring there—no less than six levels. They date from Proto-Solutrean to the latest Upper Solutrean and so give a full range of the culture. Over the latest Solutrean occur two Proto-Magdalenian levels; but these are of no especial interest. The volume is exceptionally well illustrated and will be indispensable to any student interested in the Solutrean 'episode'.

A number of poor engravings, mostly on stone, were found; to what extent the Solutreans themselves were artists, or how far the comparatively few works of art found in their levels were the work of the surviving Aurignacian folk dominated by the invading Solutreans, has long been a problem. It is only fair to say that at Badegoule quite a number of examples have been found, and the levels concerned appear to be purely Solutrean in character. The art is poor and there is much 'scrabbling'; but one or two better-drawn examples of animal figures can be noted.

It is obvious that the explorations and the publication have been a labour of love continuing for many years, and it is excellent that these painstaking and methodical studies are here so well recorded.

M. C. BURKITT

ATOMIC DEFINITION OF PRIMARY STANDARDS

By Dr. R. D. HUNTOON and Dr. U. FANO
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As matters stand to-day, the primary references for all physical measurements are the standard metre and the standard kilogram, preserved at Sèvres, France, and the mean solar day, determined by astronomical observations of the earth's rotation. The standards of length and mass are arbitrary and not independently reproducible. The standard of time is at the mercy of irregularities in the rotation of the earth. Furthermore, there are limits to the accuracy with which one can compare any physical quantity with the primary standards, and these limits are now being felt.

In view of these disadvantages, it is interesting to consider the possibility of selecting other quantities to serve in the place of the present primary standards. In particular, one might select as standards certain immutable properties of atoms or molecules with which other physical quantities can be readily and accurately compared. Any laboratory can rather easily procure samples of the appropriate atoms or molecules. According to present knowledge, such samples would be universally identical.

Recent advances in physical techniques make the use of atomic standards more than an idle speculation, for it is now becoming possible to compare certain physical quantities with atomic or molecular properties more accurately than they can be compared with the present arbitrary standards.

For example, the most precise measurements of length now made in the laboratory rely on interferometric techniques in which the unknown length is compared with the characteristic wave-length of the radiation emitted by certain atoms (such as mercury-198). The resulting uncertainty in the absolute measurement of length now lies primarily in the step where this wave-length is compared with the prototype metre. We can increase the accuracy of absolute measurement of length by adopting the characteristic wave-length as the primary standard and thus omitting metre-bar comparisons. (The prototype metre was not designed, of course, with wave-length comparisons in view.) In fact, work with optical spectra—first with the red line of cadmium and now with the green line of mercury-198—has progressed to the point where the international prototype metre is provisionally defined in terms of the cadmium red line. The International Conference of Weights and Measures held in 1948 [1] endorsed, in principle, the idea of defining the ultimate standard of length in terms of the radiation from an atom such as mercury-198 with an 'even-even' nucleus.

Similar advances have been made in the field of time standards. Recent studies in microwave spectroscopy have led to the development of an atomic clock based on a constant natural frequency associated with the vibrations of the atoms in the ammonia molecule[2].

The recent absolute determination of the gyromagnetic ratio of the proton[3] suggests the possible use of this ratio as a third basic standard. Other physical quantities could then be derived from the three atomic standards by application of suitable electrical techniques.

Thus, we are now in a position to consider the possibility of a complete set of primary atomic standards. Their adoption would remove the need for preserving arbitrary standards and for making whatever corrections are required by irregularities in the motion of the earth. The use of atomic properties as standards offers the additional advantage that they can be measured with increasingly refined techniques, and a growing variety of methods.

The establishment of primary standards based on atomic properties can proceed along the line already suggested by Michelson and Morley[4] for establishing the standard of length in terms of the wave-length of a selected spectral line. Preliminary measurements reported by the National Bureau of Standards, by the National Physical Laboratory, and by the International Bureau of Weights and Measures[5] permit present definition of the metre as 1,831,249·2 wave-lengths of the green radiation characteristic of mercury-198 in standard air. To make it independent of possible variations in air density, the atomic metre should eventually be defined as a number of waves *in vacuo*.

Similarly, the unit of time—the standard second—can be defined as the duration of a certain number of oscillations of an electromagnetic field the frequency of which lies at the centre of some well-defined microwave absorption line. The ammonia molecule has already been used for this purpose in the atomic clock, and work on the use of atomic beam techniques in the microwave range may lead to an even better standard.

The third independent unit could then be based upon the absolute measurement of the gyromagnetic ratio of the proton, making use of these previous definitions of length and time. One might, for example, proceed by defining a unit field-strength of magnetic induction as that field in which protons would precess at the rate of 4,257·84 cycles per second[3].

In principle, all other physical quantities would follow from these three. Actual definitions for the derived quantities would involve a chain of experimental measurements. In the design of the definitive measurements, one may want to exploit the accuracy of length- and time-measurements by means of interference effects. A good example of such an indirect measurement is found in a recent measurement of the velocity of light in terms of the physical dimensions and characteristic frequency of a cavity resonator[6].

It would be rash to claim that the gyromagnetic ratio of the proton, the wave-length of mercury-198, and the absorption frequency of ammonia constitute an immediately satisfactory set of atomic standards. Nevertheless, a large variety of physical quantities may be related to these fundamental standards through workable, moderately accurate procedures.

For example, unit current may be defined by the following procedure. Construct a precision solenoid the dimensions of which are known accurately in terms of the proposed standard metre. Observe proton resonance in the magnetic field of the solenoid while it is carrying direct current. The current is

adjusted until the frequency of proton resonance is a certain fraction of the frequency defined by the new standard second. The current flowing under these conditions will then be the new unit of current. To avoid confusion, the dimensions of the coil and the frequency of resonance could be selected to give the present accepted value for the ampere. The charge transported by the new standard current in unit time would then be the new unit of charge.

Similarly, a unit of force could then be defined through the use of a current balance the dimensions of which were referred to the atomic metre, so that the new unit would be the force of attraction between parallel wires when they were carrying unit current. The geometry should be selected to yield the force in terms of the present dyne or newton.

The general procedure which has been discussed here establishes as primary units the 'atomic metre, second, and gauss', or indirectly, the 'atomic metre, coulomb, second, dyne'. (The present four-standard M.K.Q.S. system follows in essence from the three-standard one by taking the permeability of free space as $4\pi \times 10^{-7}$ henry/metre.)

Mass can be derived, of course, from measurements of force and acceleration. Probably the most convenient method at the present time would be a determination of g at the location of the current balance used for force measurements. Other more accurate methods of relating mass to force might be devised.

We thus have in principle a method for deriving all physical quantities from the three suggested atomic standards; but the accuracy with which this process could be carried out is not everywhere satisfactory. Only in the case of the standard of length can present atomic measurements surpass in precision the methods based on conventional standards. The accuracy of atomic time measurements is not yet as good as the accuracy of crystal oscillators corrected by astronomical observations, but the gap is rapidly closing. The accuracy of electric measurements derived from the proton gyromagnetic ratio is still far from adequate, but there is good evidence that this accuracy will improve greatly as time goes on.

It should be pointed out that present-day measurement of atomic constants in terms of currently accepted standards constitutes, in effect, an atomic definition of these standards. Any new standard can be related to the old by a series of measurements on atomic systems. However, when it becomes possible to establish intercomparisons with atomic standards more accurately than with the accepted arbitrary standards, it will be desirable to change from the accepted standards to the new atomic standards. In length measurements, this point has now been reached, and in time measurements it is being rapidly approached. There is good promise that new techniques for the absolute measurement of nuclear gyromagnetic ratios or charge-to-mass ratios will soon put us in this position with regard to the measurement of charge and current.

The present article is intended primarily to direct attention to the possibility of adopting a complete set of atomic standards and to the various questions related to this problem. We hope that further discussion will produce better and more detailed suggestions for achieving these aims.

Even now, one may suggest that the present units be given alternate provisional definitions in terms of atomic systems and that these definitions be revised as experimental techniques improve. When measurements referred to atomic systems become more accurate than those referred to existing arbitrary standards, then the atomic definitions should supersede the arbitrary ones. In the meantime, should some unforeseen circumstance destroy our arbitrary standards, the atomic definitions would provide us with reasonably good substitutes.

For the purposes of discussion, a set of working definitions consistent with the latest values of the atomic constants, subject to further improvement, can be given:

(1) *Atomic Metre:* The length equal to 1,831,249·2 wave-lengths from the '5460·7532 A.' line of mercury-198 in standard air.

(2) *Atomic Second:* The time required for 238,701 $\times 10^6$ oscillations of the 23,870 Mc. or 3,3 line of NH_3.

(3) *Atomic Ampere:* The current flowing in an infinite solenoid of 1,000 turns per atomic metre which gives proton nuclear resonance at a frequency of 53,505·6 cycles per atomic second in a sample located at the centre of the solenoid.

(4) *Atomic Newton:* 5 million times the force exerted on each atomic metre length of either of two infinite parallel wires separated by one atomic metre and carrying one atomic ampere.

(5) *Atomic Coulomb:* The charge transported by one atomic ampere in one atomic second.

(6) *Atomic Kilogram:* The mass which experiences an acceleration of one atomic metre per atomic second squared, when acted upon by a force of one atomic newton.

[1] 9th General Conference of Weights and Measures, 1948, Sèvres, France.

[2] Lyons, H., "Microwave Spectroscopic Frequency and Time Standards", *Elec. Eng.*, **68**, 251 (1949). "The Atomic Clock, An Atomic Standard of Frequency and Time", *N.B.S. Tech. News Bull.*, **33**, 17 (1949).

[3] Thomas, H. A., Driscoll, R. L., and Hipple, J. A., *Phys. Rev.*, **75**, 902 (1949).

[4] Michelson, A. A., and Morley, E. W., *Amer. J. Sci.*, **38**, 181 (1889).

[5] Perard, A., and Terrien, J., *C.R. Acad. Sci., Paris*, **228**, 964 (1949).

[6] Essen, L., *Nature*, **159**, 611 (1947). Essen, L., and Gordon Smith, A. C., *Proc. Roy. Soc.*, A, **194**, 348 (1948).

RICE PRODUCTION AND UTILIZATION

By H. G. CLOWES

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RICE is the staff of life for more than half the world's population—about 1,000 million people—but, since the War, supplies have fallen perilously low. Pre-war consumption of rice averaged 16–18 ounces per person per day; but until recently barely enough rice has been available to provide 5 ounces per person per day in most of the urban rationed areas of the Far East.

World production of rice in 1949–50 has virtually recovered the pre-war level; but the increase was due largely to expanded production in the minor producing areas, while Asia's rate of recovery still lagged behind the rate of population increase. This gap has been only partially filled by the substitution of wheat and other grains.

The accompanying table shows the production of paddy in 1949–50 by the major producing countries, compared with pre-war and 1946–47.

PRODUCTION OF PADDY (ROUGH RICE) IN THE PRINCIPAL PRODUCING AREAS

Area	Pre-war	1946–47	1949–50*
	(Million metric tons)		
India	32·2	32·7	33·2
China	52·1	47·4	46·7
Pakistan	11·2	12·8	12·3
Indochina	6·5	4·3	5·5
Burma	7·0	3·8	4·2
Indonesia	9·9	7·6	9·9
Japan	11·5	11·5	11·5
Siam	4·4	4·6	5·6
Philippines	2·2	2·2	2·5
Korea	3·9	2·8	3·5
Brazil	1·4	2·7	2·5
U.S.A.	1·0	1·5	1·8
Egypt	0·6	0·9	1·2
Total Asia	142·3	130·8	136·1
Total other areas	7·0	10·2	10·8
World total	149·3	141·0	146·9

* Preliminary.

Good varieties, good cultural and irrigation practices, prevention of disease, improved harvesting methods, storage that prevents loss of grain already harvested, and the best nutritional use of the grain are among the basic prerequisites to better production and consumption of rice. This has been recognized in national and international efforts since the War to increase rice supplies for the Far Eastern consumer.

Good varieties should produce high-grade rice in areas where they are grown, and should have a reasonably wide range of adaptation. Many indigenous varieties in Asia are reported to have a rather narrow range of adaptation, whereas others have a relatively wide range. If the large number of varieties could be reduced to one-tenth or even less of their present number (there are more than two thousand known varieties in India alone) pure seed production and distribution would be much easier to initiate, and breeders could give more attention to the further improvement of varieties grown over large areas.

Good varieties should be resistant to disease, to lodging (especially important as shorter—and stronger—strawed varieties come into demand with increased mechanization), to shattering, and, for specific areas, should be tolerant of saline soils.

Early maturity is important: early varieties require less water. They tend to be shorter-strawed and produce less vegetative growth, making them better adapted to mechanized harvesting. In many cases, earlier maturity would also make it possible to grow two crops each season instead of one. Some of the early maturing varieties yield heavily under favourable conditions, as has been amply demonstrated in India and Japan. The later maturing varieties are, of course, better adapted to some areas and more useful there.

The International Rice Commission (a body representative of seventeen countries which forms part of the U.N. Food and Agriculture Organisation), with headquarters in Bangkok, Siam, is working on projects to improve cultural practices. Better varieties are being developed and better methods of seed distribution proposed. Lack of adequate distribution facilities has slowed the use of improved seed by many Asiatic rice farmers.

The battle against disease and pests of growing rice is partly a matter of planting varieties which are resistant and partly a matter of combating these enemies in the field.

Piricularia oryzæ (or blast) is an important rice disease in India and Japan, where losses range from 10 to 20 per cent in affected areas. Both these countries have developed, by selection from indigenous varieties and from crosses, varieties of rice that are resistant to *Piricularia*. Efforts are being made in Iraq and other nearby rice-producing areas, where damage from *Piricularia* is severe, to import seed of rice varieties which are more resistant to this disease than are local varieties. *Piricularia* in Japan is believed to be related to the low temperature and the high fertility maintained in Japanese soil by the liberal use of nitrogenous fertilizers. This suggests that the disease may become more serious in other Asiatic countries as the use of nitrogenous fertilizers increases, and that a lack of nitrogen fertilizer may be largely responsible for the fact that *Piricularia* and perhaps some other diseases are not apparently important yield-limiting factors in Burma, Ceylon, Indonesia and Siam.

India is also actively working on the *Helminthosporium* disease (brown spot), which causes losses up to 80 per cent in affected areas in years when it occurs in epidemic form. Methods have been developed in India for testing the resistance of rice varieties and selections against this disease.

Stem borers cause enormous losses in rice, especially in South China, where the infestation is very severe in most years. Virtually nothing has been done to investigate the entomological and breeding aspects of insect control in rice. However, the use of resistant varieties should be one of the most successful methods of combating stem borers. It is, of course, very difficult in the present political and economic situation in the East to pursue the steps necessary to the development of varieties resistant to borer.

Among the more unusual pests of rice is a burrowing fish which causes considerable damage to the rice fields of Viet Nam. As reported to the International Rice Commission, by a government representative, the fish (*Gobioides anguillaria*) makes tunnels through the bunds between rice fields as a means of migrating from lower to higher fields. This in many cases results in draining the higher fields and causing severe damage to the rice crops. The counter-attack used against this unusual form of pest is equally unusual. The leaves of the tree *Milletia ichthyochtona* are gathered, and chopped into fine pieces, which are scattered in the water covering the rice-field. A substance in the leaves kills the fish. A small amount of piscidine, an extract of the nut of the same tree, when dropped into the water, is also fatal to these fish. The dead fish, bloated by the gases of decomposition, stop up the tunnels they have bored, and help to prevent further loss of water from the fields.

The tadpole shrimp (*Apus oryzaphages* and *A. biggsi*) invaded a number of rice fields in California in 1946. Young plants were attacked after germination. Young leaves were chewed off, and growth of the seedlings was slowed up by muddying the water in the fields. This pest was effectively controlled by the application of 10 lb. of copper sulphate to an acre of paddy.

Damage to rice during harvesting and storage of the crop is severe but can be controlled. A conference of Asiatic nations, held recently under the auspices of the Food and Agriculture Organisation, estimated that rodents alone are responsible for the damaging and destruction of more than 12 million tons of rice each year. Most of this damage occurs in storage; but large quantities of rice are destroyed in the field. In Indonesia, for example, it has been found that harvesting the rice a little while before it

is fully ripe not only saves grain that might be lost by shattering, but also helps to reduce the rat population in the fields. When less scattered rice is left for rats to pick up, the rodents fail to get their usual supply of vitamins necessary for large litters, and their increase is smaller. In many places of the Far East old storage houses are being cleaned and made rodent-proof, and new stores are being built. An old-fashioned method of rodent control is being revived in Malaya. The rice godowns are first surrounded by snakeproof fencing. Then an expedition is made into the nearby jungle to capture pythons, which are given a home under the floor of the godown. There is no rat problem in the godowns policed by pythons.

Efforts have been made by governments to improve handling facilities at the rice mills; but they have not met with complete success. For example, a rice mill in Bangkok has recently completed a modern rice-storage plant on the Chao Phya River. The most up-to-date mechanical process has been installed to unload the paddy by sucking up the grain from the sampans and elevating it into the bins. But many local boatmen have refused to use the modern storage elevator. They are afraid that the boat and all its contents, including the boatman's family, will be drawn into the pipe with the paddy. They prefer to use the conventional and less economical method of unloading by coolies, each coolie carrying two baskets on a wooden yoke balanced across his shoulders. The modern elevator can unload a large sampan with six or eight tons of paddy in less than thirty minutes; but it takes several hours by the more conventional hand method.

Another bottleneck in the rice situation is the unsettled political and economic situation in many areas, such as China, Indo-China and Burma, where rice production has decreased below that of 1949 and 1948. Lack of adequate police protection from roving guerrilla bands has forced rice farmers to abandon temporarily fields some distance from their villages, thus reducing the area under rice. Guerrillas have also caused complete failure of normal transportation systems to bring the paddy to the mill. In Burma, before the War, it was possible to bring paddy down the Irrawaddy River from the rice-growing area north of Rangoon in large barges carrying 1,000–2,000 tons each. Guerrillas and bandits have now made this practice practically impossible. Armed convoys of ten or fifteen trucks must now be organised, each carrying approximately 1·5 tons, to transport rice to the mills. The convoy is often halted by armed men and must pay tribute before passing on. In spite of these difficulties, Burma exported 1,200,000 tons of rice in 1949 to feed people in the Far East; but costs of delivery have increased many times above pre-war.

One way to make the most of rice supplies, of course, is to see to it that the nutrients of rice are preserved and consumed. In an area where the protein foods are scarce, and where beriberi is a common nutritional disease, the Food and Agriculture Organisation has found that milling may cause a loss of 15 per cent of the protein present in husked rice, and as high as 75 per cent of the thiamine, which is essential to prevent beriberi. Rice supplies are frequently so dirty that they require excessive washing in the home. Through excessive washing and improper cooking, 10 per cent of the protein, 10–15 per cent of the calorie value, and 80 per cent of the thiamine may be lost.

The Food and Agriculture Organisation has long recommended under-milling practices, parboiling of rice before milling, educational campaigns for better cooking of rice, enrichment at the mill, and more diversified diets for the rice-consuming people of the world, which represents more than half of the total. The nutritive value of rice strains needs research and continuing consideration in breeding programmes for better varieties.

Dietary changes are taking place in the Far Eastern rice area, including a trend in some sections away from rice as a staple food. This trend has been caused by a scarcity of rice and the economics of the situation. Rice prices have increased six or eight times since before the War, whereas wheat prices have only doubled in the same period. Two tons of wheat can usually be bought for the same price as one ton of rice. A new generation is growing up without the usual dependence on rice. Some authorities believe a number of areas may never again go back completely to rice as a staple cereal.

PHYSICO-CHEMICAL PROPERTIES OF NUCLEIC ACIDS

A SYMPOSIUM on the physico-chemical properties and behaviour of nucleic acids, organised by the Colloid and Biophysics Committee of the Faraday Society, was held at the Institut Français, London, on May 12. The choice of this subject is indicative of the recent growth of interest in the chemistry of nucleic acids. Although nucleic acids were first isolated nearly eighty years ago, it is only in the past decade that some knowledge of the size, shape and structure of these macromolecules has been obtained. The topics dealt with in the symposium were representative of the research in progress in Great Britain and on the Continent of Europe. Prof. E. K. Rideal (London) presided during the morning, and during the afternoon Prof. R. Signer (Berne) and Prof. V. Desreux (Liège) shared the duties of chairman. Abstracts of the papers submitted will be published in the *Transactions of the Faraday Society*.

Ribonucleic acid preparations which have been studied by various physico-chemical techniques, and which have been used in biological studies, are very heterogeneous, and the preparation of homogeneous fractions by electrophoretic and ultracentrifuge methods have proved difficult. By fractionation of samples prepared from yeast, *B. coli*, pancreas and chicken embryo, using the different solubilities in aqueous alcohol, Prof. Desreux has isolated ribonucleic acid fractions which from solubility data appear homogeneous. Two main fractions of ribonucleic acid were isolated in each case, having molecular weights of 50,000 and 5,000. The particles of the high molecular-weight fraction were asymmetric, having an axial ratio of 9 : 1. The physico-chemical characteristics, for example, diffusion and sedimentation constants, axial ratio, electrometric titration curve and solubility, indicate that the fractions of ribonucleic acid prepared from yeast and *B. coli* are similar.

The electrometric titration of deoxypentose nucleic acids was discussed by Mr. D. J. Cosgrove (Nottingham) and Dr. A. R. Peacocke (Birmingham). Mr. Cosgrove described the anomalous titration curve obtained with a sample of deoxypentose nucleic acid which had been prepared by keeping all solutions at or very close to *p*H 7. Addition of acid or alkali to

a solution of the sodium salt at *p*H 7 does not at first bring about the titration of groups in the *p*H range 5–11; the titration of groups is delayed until a critical *p*H region is reached, where the liberation of ionized groups occurs rapidly. The back-titration curves, either from *p*H 12 or 2·5, are more normal and agree with the calculated curve based on a knowledge of the dissociation constants of the purine–pyrimidine amino groups and $-NH-CO-$ ('hydroxyl') groups. The reaction which occurs on the addition of acid or alkali is irreversible, and a similar change occurs on heating the solution of the sodium salt of the deoxypentose nucleic acid. The anomalous titration curve is not affected by the method of preparation of the nucleic acid so long as treatment with acid or alkali is avoided; this is particularly interesting in that two very different methods of separating the nucleic acid from the protein were employed, namely, the chloroform gel method and the salt precipitation method, and thus confirms the findings of Prof. Signer (see below). Similar titration curves have been obtained for acids prepared from calf thymus, herring sperm and from lamb thymus, and it would appear that the anomalous titration curve is characteristic of all deoxypentose nucleic acids. The anomalous titration curve has been explained by postulating the existence of hydrogen bonds between the $-NH-CO-$ groups and the $-NH_2$ groups of different purine and pyrimidine rings in the acids as initially prepared. Dr. Peacocke pointed out that the titration curves obtained by him did not quite agree with those of Mr. Cosgrove, in that the back-titration curve from *p*H 12·5 was not identical with that from *p*H 2·5. The effect of ultrasonic vibration is to produce degradation of the nucleic acid and, like heat and alkaline treatment, to destroy the anomaly in the titration curve.

In the preparation of high molecular-weight deoxypentose nucleic acid, which was described by Prof. R. Signer (Berne), the most important precaution is the inhibition of nuclease activity by cooling to $-80°$ C. and by the addition of enzyme inhibitors. Prof. Signer also considers it is essential that the nucleoprotein prepared by extraction with 10 per cent sodium chloride solution be repeatedly purified by precipitation, which is achieved by diluting the solution to 1·0 per cent sodium chloride concentration. The molecular weight and viscosity are not affected by the method of separating the nucleic acid and protein, and either the chloroform-gel or the salt-precipitation method may be employed.

An X-ray study of nucleosides and nucleotides has been made by Dr. S. Furberg (Oslo), and was described by Dr. C. H. Carlisle (London). In cytidine the pyrimidine ring is flat, and the ribose ring, for which there is some evidence that it is not planar, lies in a plane perpendicular to that of the pyrimidine. The structure of cytidylic acid is similar, the phosphoric acid being attached to the 3′ position. The study of the structure of nucleic acids has been carried to a stage where it is possible to postulate, on the basis of packing considerations, two arrangements of the nucleotides. One is a straight-chain structure, the nucleotides being arranged in the form of a zigzag, and the other is a spiral structure. Both structures give a fibre spacing in agreement with that observed previously by Prof. W. T. Astbury.

Dr. D. P. Riley (London) gave an account of the wide-angle X-ray scattering of solutions of the sodium salt of deoxypentose nucleic acid. At low concentrations, only small-angle scattering is observed but at concentrations greater than 5 per cent there are three distinct regions of refraction at 3–10, 20–50 and 50–200 A. At these rather high concentrations, the solutions are really liquid crystals and exhibit marked domain birefringence. The higher spacings vary as $1/5\ C$, where C is the volume concentration. These data have been interpreted as indicating that the molecules are cylinders of diameter 46 A., presumably formed by the coiling of the long chain; on dilution the separation between the cylinders increases. The scattering which is observed with nucleoproteins is somewhat different, the larger spacing being absent.

The problems involved in the determination of the molecular weight of nucleic acids by means of the ultracentrifuge were considered by Dr. A. G. Ogston (Oxford). Marked molecular interaction makes it necessary to extrapolate the sedimentation and diffusion constants to zero concentration. The sedimentation constant S may be satisfactorily extrapolated as $1/S$ against concentration to give a limiting value for the deoxypentose nucleic acid of calf thymus of $13{\cdot}2 \times 10^{-13}$. The extrapolation of the diffusion constant is performed with the aid of Flory's theory of the entropy of solutions of large particles to give a value of $0{\cdot}55–0{\cdot}70 \times 10^{-7}$. The molecular weight then lies between $1{\cdot}0$ and $1{\cdot}3 \times 10^6$, and the axial ratio is 140–170, which is in reasonable agreement with the value of 190 obtained from viscosity measurements when using a high rate of shear.

Light-scattering measurements on dilute solutions of the sodium salt of deoxypentose nucleic acid were described by Dr. G. Oster (London). The molecular weights of the samples studied varied from 0·51 to $3{\cdot}23 \times 10^6$ according to care of preparation, and were independent of concentration of electrolyte up to 0·2 M. Measurement of the angular scattering with incident and scattered light under polarizing conditions indicates that the nucleic acid particles are rods with strong negative birefringence and are not random chains. Viscosity measurements on the same samples are in accord with the light-scattering results if it be assumed that the diameter of the particle is approximately 40 A. This value, which is in agreement with the X-ray scattering results of Dr. Riley, has been confirmed by some preliminary electron micrographs (made by Mr. H. L. Nixon), which show that the nucleic acid particles are fibres with a diameter of approximately 50 A.

Dr. S. Jungner (Stockholm) then described the dielectric properties of deoxypentose nucleic acids. The molecular weight of a thread-like molecule with a permanent dipole moment such as deoxypentose nucleic acid may be calculated from the anomalous dispersion of the dielectric constant. In nucleic acid the individual dipoles are oriented across the long axis of the molecule, so that the dipole moment is proportional to the number of nucleotides and therefore to the molecular weight. The values of the molecular weight obtained in studies on dilute solutions are somewhat lower than those obtained by ultracentrifuge and light-scattering methods, being in the range $1–6 \times 10^6$. Also in contrast with the light-scattering results is the observation from dielectric measurements that the particle weight decreases considerably to a value of 35,000 on the addition of electrolyte. These results are interpreted as indicating a reversible disaggregation rather than the coiling process hitherto suggested as the cause of the decrease in viscosity. The addition of magnesium ions appears

to have a specific effect in bringing about irreversible changes; on precipitation of the nucleic acid with ethyl alcohol in the presence of magnesium ions, large artificial aggregates are formed.

The behaviour of nucleic acids as polymeric electrolytes was discussed by Dr. D. O. Jordan (Nottingham). The nucleic acid polymer contains both strong and weak electrolytic groups, and the presence of the former and the ionization of the latter affect the viscosity of its solutions and the shape of the titration curve. The viscosity of deoxypentose nucleic acid shows considerable structural character, and the viscosity at low pressures is high. The addition of electrolyte reduces the viscosity considerably, as has also been described for simpler systems, for example, polymethacrylic acid and poly N-*n*-butyl-4-vinyl pyridonium bromide. This process is explained by the repulsion of the charged groups (PO^- at *p*H 7) maintaining a stretched polymer in aqueous solution. The addition of electrolyte reduces this repulsion, thereby permitting the molecule to coil, thus producing a more symmetrical molecule and reducing the viscosity, the structural character of the viscosity and the streaming birefringence. The analogy between nucleic acids and synthetic polymeric electrolytes cannot be carried too far, since the number of *gegen*ions absorbed into the micelle is large, as indicated by the value of 550*e* for the charge per molecule in a solution of ionic strength 0·005, compared with the calculated value of 2664*e* for a molecule of molecular weight $8{\cdot}2 \times 10^5$. The presence of the *gegen*ions in the micelle will reduce the number of effective ionized groups, thereby decreasing the repulsion. The dissociation constants are all found to be weaker than in the monomer. Calculation of the *p*K values at different degrees of ionization for the $-NH-CO-$ dissociations shows a decrease in acid strength as ionization increases; the initial value, however, is weaker than that for the nucleoside. This is presumably due to the presence of the PO^- groups. The case of the amino groups is more complicated, the field effect produced by the ionization to NH_3^+ and by the PO^- groups operating in opposite senses.

The degradation of deoxypentose nucleic acids by chemical agents was outlined by Dr. J. A. V. Butler (London). The extent of degradation was followed by measurement of viscosity. The action of X-rays had been shown previously to produce degradation during the irradiation and to give an after-effect in which the degradation continued after the source of radiation had been removed. This after-effect has now been shown not to occur in the absence of oxygen and is probably due to the presence of hydrogen peroxide or HO_2 radicals in solution. A similar degradation to that produced by X-rays may be obtained from the action of free hydroxyl radicals formed by the irradiation of hydrogen peroxide by ultra-violet light or by the reaction between the ferrous ion and hydrogen peroxide. Similar degradation is observed by the action of sulphur and nitrogen mustards. Ultracentrifugal analysis of the degradation products, by Dr. B. E. Conway and Dr. L. Gilbert (London), has shown that there is a considerable reduction of the molecular weight from 1×10^6 to about 1×10^5, the products being very heterogeneous and containing some low molecular-weight fractions which diffuse very rapidly. These degradations, however, are not nearly so extensive as that produced by the action of deoxyribonuclease.

D. O. JORDAN

BRITISH LEATHER MANUFACTURERS' RESEARCH ASSOCIATION

By DR. HENRY PHILLIPS
Director

INCORPORATED in 1920 and starting with a modest income, the British Leather Manufacturers' Research Association at first rented laboratory space for its small staff in London at the Battersea Polytechnic, the Lister Institute and the Imperial College of Science and Technology. Largely the child of the heavy leather industry, the Association rejected the late Prof. A. Smithells's suggestion that its headquarters should be near the Leather Industries Department of the University of Leeds, then guided by Prof. H. R. Procter, because the tanneries in the Leeds area mainly produce light leathers; although scientifically similar, there are fundamental differences between the processes of these two sides of the industry. The Association therefore went to London, where it was near the headquarters of the United Tanners' Federation and the Federation of Light Leather Tanners and Dressers, and also the heavy and light leather industries of Bermondsey.

When Dr. Dorothy Jordan Lloyd succeeded the first director, Dr. R. H. (later Sir Robert) Pickard, the staff was gathered together in laboratories set up in St. Thomas Street, London, S.E.1. Industrial support for the Association grew steadily, and by 1938 sufficient reserve funds had accumulated to enable more commodious laboratories to be furnished in Nelson Square, Blackfriars Road, London. These laboratories were carefully planned and provided a compact and convenient research centre. Occupied in 1939, they were not destined to survive very long, for they were badly damaged in the bombing of 1940, fortunately at night during the absence of the staff. Space for about half the staff was improvised on the ground floor and in the basement of the bombed building; the remainder found accommodation first at Rothamsted Experimental Station and the Leathersellers' Technical College, and later in a large laboratory above the Royal Institute of Chemistry.

At the end of the War, permission to reinstate the laboratories in Nelson Square was refused. The industry was reluctant to move the Association from Bermondsey; but, after the death of Dr. Jordan Lloyd in 1946, a review of the circumstances suggested that the prospects of rehousing within the London area were slight. The Association therefore decided that a search should be made to find a country mansion suitable for conversion and within a radius of twenty miles of London. The final choice fell on Milton Park, a large Georgian-type mansion, situated in thirteen and a half acres of grounds and within walking distance of Egham Station. After a public inquiry, opposition to the conversion was withdrawn. Fairly extensive repairs and modifications to drainage and supply services had to be made; but in a little more than a year the conversion was completed, and the new laboratories were opened by H.R.H. the Duchess of Kent on May 22.

The leather industry is often referred to as a traditional industry, with the implication that the tanner is conservative and reluctant to adopt new methods. This is a superficial view: industries remain traditional so long as scientific knowledge lags behind empirical knowledge. Fibre science and

the fibre scientist are relative newcomers to research laboratories: the tanner from time immemorial has been modifying collagen fibres, and until recent times his control over his empirical processes was necessarily precarious. Realizing this, he was naturally reluctant to experiment.

Unlike the textile manufacturer, the tanner obtains his fabrics—hides and skins—already woven; he is essentially a finisher of these fabrics, not only in the sense that he makes the fibres more resistant to water and micro-organisms, but also because he may modify profoundly the physical properties of the fibres. In the manufacture of sole leather, for example, where solidity and firmness are required, the collagen fibres become impregnated with as much as seventy per cent of their weight of vegetable tannins. This transformation is accomplished without serious disturbance of the original fibre weave and pattern. In light leather manufacture, where flexibility is the main consideration, the tanner alters the fibre far less; he is more concerned with decreasing their reactivity by sealing off their amorphous regions and by cross-linking the polypeptide chains.

Such a brief review in terms of modern fibre science could not have been made in 1920. Yet it explains how the past work of the Research Association has followed certain paths to satisfy the tanner's needs. The British tanner has searched the world for hides and skins with fibre structures suitable for specific leathers; thus, a Sudanese sheepskin will yield a gloving leather far superior to that obtained from a merino sheepskin. Methods of preserving hides and skins for transport became, therefore, an early subject for research. So also did the histological examination of all animal hides and skins in order to correlate their fibrous structures with the physical properties of the leathers they gave. Microscopical examination of hides and skins during their conversion into leather was and is still widely studied, so that to-day, for example, the wearing qualities of a sole leather can be assessed from the microscopical examination of a thin cross-section.

The classical work of Procter on the combination of gelatin with acids and alkalis, and the interpretation of the resulting swelling by the membrane equilibrium theory of Donnan, has obvious applications in the leather industry. Investigations in heavy leather tanneries, along the lines now known as operational research, showed that control of the swelling of the fibres in the acid vegetable tan liquors is necessary in order to facilitate the penetration of the tannins into the interfibrillary spaces in the hides. Later investigations revealed the importance of the concentration of acids and salts in the tan liquors as factors controlling the rate at which the collagen fibre structure is loosened to enable tannins to penetrate and become fixed in the fibres themselves. Empirically the tanner had found that, by using blends of extracts of tannin materials from different parts of the world, he could modify the fibres and facilitate the fixation of tannin, although he was unaware that blending gave him the requisite concentrations of acids and salts he required.

Using *p*H control, the tanner can regenerate the weak acids of his tan liquors by the addition of sulphuric acid. The use of strong acids in tanneries was blamed for the tendency of some bookbinding and upholstery leathers to rot and become powdery. Many years of investigation were necessary to prove that the sulphuric acid found in rotted leathers originated from the sulphur dioxide in town atmospheres which was absorbed by leather and oxidized to sulphuric acid under the catalytic action of iron impurities. Treatment of the leather with oxalates or pyrophosphates which sequester the iron makes the leather inert towards sulphur dioxide and hence capable of withstanding polluted atmospheres.

In more recent years the demand for specification of imported manufactured goods in countries anxious to build up secondary industries has caused increased attention to be paid to methods for measuring the physical properties of leather, and this development was taken into account when planning the laboratories at Milton Park: adequate facilities have been installed for the comprehensive study of the physical properties of collagen and leather fibres and of leather in bulk. One of the aims of the Physics Department is to strengthen the morale of the industry, which under the impact of the extensive publicizing of synthetic products has forgotten why it adopted the slogan "There is nothing like leather". This is not surprising, since many men of science are woefully ignorant of the unique properties of the natural fibres and fibrous materials.

Some people have assumed that a model tannery will be erected at Milton Park: nothing could be further from the truth. The liaison department of the Association has many tanneries in which to make extra-mural experiments on existing processes. Radical departures from present methods of leather making which may come in the future will have to be developed before the industry will consider their adoption. For such development work, space is necessary and is now available. Lastly, the recent extension of the work of the Association to include the study of the engineering problems of the industry is not without bearing on future development work.

There are many indications that the Association has moved to its new laboratories at a stage in the development of fibre science which will enable existing processes to be placed under even more rigid control and may lead to the development of new and probably less arduous tanning processes.

OBITUARY

Dr. A. J. Bull

Dr. Alfred Joseph Bull, who died on April 15 in his seventy-fifth year, made notable contributions to both photography and geology. From 1903 until 1946 he was associated with the School of Photo-Engraving and Lithography, having been principal since 1912. The advancement in photo-engraving during this period owes much to the research work carried out by Dr. Bull and his colleagues at Bolt Court, Fleet Street. During the Second World War, Dr. Bull and his staff were engaged, among other activities, on a number of special investigations for government departments. Particularly noteworthy was the work leading to the production, on a large scale, of graticules of extremely high precision for a wide range of purposes. Dr. Bull was also a pioneer in colour photography, and enjoyed international reputation as an expert in currency and security printing. He was a founder member of the Institute of Physics, and was president of the Royal Photographic Society in 1933 and 1934, the latter the year of the Fox Talbot Centenary celebrations.

Geology was Dr. Bull's other chief interest. With characteristic thoroughness he attended the full

course at the South Western (now Chelsea) Polytechnic and took his B.Sc. in geology in 1917. The following year his work on colour reproduction gained him the degree of M.Sc., this time in physics; but he returned to geology for his Ph.D. in 1937. His original work in geology was mainly in two widely separated fields. For many years he published a series of important papers, either alone or in collaboration, on the geomorphology of the Weald. He was, in particular, a strong advocate of the effects of the cold conditions of the Pleistocene period in moulding the characteristic land-forms of the South Downs. This work was part of the programme of the Weald Research Committee of the Geologists' Association. When the Committee was first formed in 1923, Dr. Bull was elected chairman, and he continued to hold this office until his death. A field meeting of the Association to the Swiss Alps in 1926 stimulated his interest in the problems of major tectonics. He developed theories, notably on the importance of gravity as a geological agent, which were at first regarded critically in several quarters, but which slowly gained increasing recognition.

But this research work, in the leisure moments of a busy life, was not Dr. Bull's sole contribution to geology. He was president of the Geologists' Association during 1926–28, and for many years acted as one of its secretaries. He also served as treasurer of the Mineralogical and Palæontological Societies. Owing to his own expert knowledge and the facilities of Bolt Court, his published papers were enriched by illustrations of the highest quality. In this field he never spared himself in helping others, and the extremely high standard of illustration reached in recent years by several geological journals is largely due to the technical advice and help given so readily and generously by Dr. Bull. J. F. KIRKALDY

NEWS and VIEWS

Prof. J. H. Andrew

IT will be a matter of great regret to his many friends in metallurgical circles that Prof. J. H. Andrew, who has been professor of metallurgy in the University of Sheffield since 1932, retires for reasons of health at the end of this summer. A graduate of the honours school of chemistry in the University of Manchester, Prof. Andrew was for some time chief of the Metallurgical Research Department of Messrs. Armstrong Whitworth and Co., Ltd., Manchester, and from 1920 until 1932 he held the chair of metallurgy in the Royal Technical College, Glasgow. At Sheffield he has made widespread changes in the Department of Metallurgy. Obsolete equipment was quickly replaced and the curriculum brought into line with modern ideas. Buildings were extended and modernized by the provision of the Hadfield Laboratories in 1938, while in the post-war years the Department has been almost completely re-equipped, so that its facilities are adequate to meet any demands that teaching or research may make. Prof. Andrew's versatility is shown by the wide field covered by his numerous researches, which include steel making and founding, constitution and transformation of alloy steels, cold-working, gases in metals and related subjects. The recognition of his eminence as a research worker by the award of the Bessemer Medal of the Iron and Steel Institute in 1949 gave great pleasure to the numerous metallurgists he has trained in the method and spirit of research. The important positions throughout the industrial world now occupied by these men testify to the quality of that training. His departure will be felt as a loss in university circles at Sheffield outside his own Department, for both he and Mrs. Andrew have contributed much to the general affairs and social life of the University, and many have reason to remember their generous hospitality.

Physiology at Edinburgh: Prof. D. Whitteridge

DR. DAVID WHITTERIDGE, who has been appointed professor of physiology in the University of Edinburgh in succession to the late Prof. W. H. Newton, has been a fellow of Magdalen College since 1945, and a demonstrator in the Physiology Laboratory at Oxford since 1938. Previously, he had been a Demy of Magdalen, obtaining first-class honours in physiology in 1934, and afterwards pursuing clinical studies at King's College Hospital. He has been a Beit Memorial Fellow and a Schorstein Research Fellow. He is senior secretary of the Physiological Society. Dr. Whitteridge's scientific work has been mainly in nervous and cardio-vascular physiology. He investigated synaptic transmission through the ciliary ganglion with J. C. Eccles. Working during the War on the physiology of blast, he was especially interested in the mechanism of rapid and shallow breathing. He found that it cannot be ascribed to sensitization of stretch receptors, and during the search for other afferent systems he has described the impulses in afferent fibres from the great veins, and a new set of afferent fibres probably arising from the pulmonary vascular bed. After the War, Whitteridge collaborated with Dr. Ludwig Guttmann in studying the cardio-vascular effects of visceral distension in patients with complete section of the spinal cord. This work directed attention to the existence of widespread spinal vascular reflexes in man and to the limitations to the compensatory activity of higher centres. More recently, in collaboration with Dr. Peter Daniel and Miss Sybil Cooper, he has been investigating the afferent impulses arising from mammalian eye-muscles, and is engaged in tracing the central connexions of the afferent fibres within the brain-stem.

Geology at Durham: Dr. K. C. Dunham

DR. K. C. DUNHAM, petrographer of the Geological Survey, has been appointed to the chair of geology at the University of Durham in succession to Prof. L. R. Wager (see *Nature*, June 24, p. 998). Dr. Dunham is a Durham graduate who, following upon post-graduate researches on the geology of the Pennine ore field, spent three years (1932–35) as a Commonwealth Fellow at Harvard University, working principally on the mineral deposits of the Organ Mountains of New Mexico. On his return to Britain he was appointed a geologist on the Geological Survey. His investigations within the Government service have for the most part been concerned with problems of economic geology, work on the Furness iron ore fields of Lancashire and on the lead–zinc–fluorspar–barium mineralization of the Pennines being particularly noteworthy in this connexion. In recognition of the scientific and industrial value of these

studies, which have been published principally as memoirs and 'Wartime Pamphlets' of the Geological Survey, Dr. Dunham was awarded the Murchison Fund of the Geological Society in 1942 and the Goldfields Medal of the Institute of Mining and Metallurgy in 1945.

As head of the Petrographical Department of the Geological Survey since 1945, Dr. Dunham has been in charge of the systematic study of British rocks, and has also undertaken a wide range of investigations into the industrial applications of rocks and minerals. Despite these responsibilities, he found time to edit the comprehensive symposium on the geology, paragenesis and reserves of the lead and zinc ores of the world, published by the International Geological Congress in 1948. He takes to the University of Durham the breadth of interest and economic outlook that necessarily characterize the work of the senior officers on the Geological Survey, no fewer than six of whom have preceded him to university chairs within the past five years.

Astronomy at the Australian National University

Dr. R. v. d. R. Woolley, director of the Commonwealth Solar Observatory at Mt. Stromlo, Canberra, has been appointed honorary professor of astronomy in the Research School of Physical Sciences of the Australian National University. By arrangement with the Minister for the Interior, Dr. Woolley will retain his position as director of the Observatory. In announcing this appointment, the vice-chancellor of the University, Sir Douglas Copland, said that students at the Australian National University would now be able to undertake research work at the Stromlo Observatory.

International Scientific Radio Union

The Ninth General Assembly of the Union Radio Scientifique Internationale will be held in Zurich during September 11–22. Sir Edward Appleton is president of the Union which, in accordance with resolutions passed at the previous Assembly in Stockholm in 1948 (see *Nature*, **163**, 493; 1949), now organises its scientific work under seven commissions, the titles and presidents of which are as follows: (1) Measurements and Standardization, Dr. J. H. Dellinger (United States); (2) Troposphere and Wave Propagation, Dr. C. R. Burrows (United States); (3) Ionosphere and Wave Propagation, Sir Edward Appleton (Great Britain); (4) Terrestrial Atmospherics, Prof. H. Norinder (Sweden); (5) Extra-terrestrial Radio Noise, Dr. D. F. Martyn (Australia); (6) Waves and Oscillations, Prof. Dr. van der Pol (Netherlands and vice-president of the Union); (7) Electronics, Dr. G. Lehmann (France). The British National Committee for Scientific Radio is organised under the auspices of the Royal Society as a constituent member body of the Union Radio Scientifique Internationale. This Committee has nominated the following British delegates to the forthcoming general assembly, the numbers of the commissions to which they are specially responsible being indicated in brackets: Mr. C. W. Oatley (1), Dr. R. L. Smith-Rose (2), Dr. W. J. G. Beynon (3), Dr. J. W. Findlay (4), Dr. A. C. B. Lovell (5), Group-Captain W. P. Wilson (6), and Prof. J. Sayers (7). In addition, a small number of observers has been appointed by the Committee to attend the meeting in Zurich.

In accordance with established procedure, the various national committees will submit to the General Assembly progress reports reviewing the advances made within their own countries in each of the fields of research designated by the seven commissions. These reports will be supplemented in some cases by short original contributions describing recent research work of direct interest to the international aspects of scientific radio. National delegations may also submit any proposals for international action, which may include theoretical and experimental research, and, where desirable, standardization of equipment and nomenclature. Certain proposals of this nature have already been submitted to the Union by the Comité Consultatif International des Radio-communications, which is a technical committee responsible for advising the International Telecommunications Union on all aspects of practical radio communication. This arrangement forms a very satisfactory liaison whereby the fundamental problems confronting the practical engineer may be brought to the notice of the man of science, who may then be expected to seek a solution.

Prehistory of Africa

For many years, Mr. E. J. Wayland was the Government geologist in Uganda, and it is safe to say that there is no one who knows more than he does of the complicated geological structure and tectonics of that country. Not unnaturally, he has also concerned himself with the problems of the prehistory of the region, since it abounds with the relics of Stone Age man. He had, indeed, intended to write a definitive work on the matter, and for this purpose had made extensive collections of stone tools; but then came the Second World War and everything had to be put off. In the meantime, too, a book called "The Prehistory of the Uganda Protectorate" had been published by T. P. O'Brien. But many of Mr. O'Brien's conclusions are not accepted by Mr. Wayland, and it is still very much to be hoped that he will publish his considered opinions on the very complicated problems which the country presents. As something to be going on with, however, he has published some notes (*S. African Arch. Bull.*, **5**, No. 17, March 1950), all of which are worth while and stimulating. With reference to the Kafuan industries of Uganda, for example, he alludes to his prolonged searches for the original source of the earliest tools, which he says were finally run to earth in laterite ironstone deposits of the End-Tertiary peneplain, and may therefore be of the order of a million years old; and he has some astonishing figures about the prolificacy of implementiferous pits which he sank at Nsongezi in the Kagera valley. To these thought-provoking notes he has added a number of pages of his ideas on man and the Kalahari Desert and stone age research in Bechuanaland, with a list of basic considerations that he feels are important, and the Stone Age sequence in the latter country. Desmond Clark, of Livingstone, has recently concluded an extensive study of the Zambesi gravels and prehistoric man, and investigations of the Kalahari sands in Angola and their relation to Stone Age man are also taking place, so it is much to be hoped that a pooling of ideas in these fields will be possible and some definitive conclusions reached.

Unsaturated Polyester Resin for Biological Use

The March number of the *Museums Journal* includes a paper by P. E. Purves and R. S. J. Martin, of the British Museum (Natural History), describing some techniques that they have recently developed with a series of resins of the unsaturated polyester

class. The resins of this type are marketed in Great Britain under the trade name of 'Marco Resins', and one of these, namely, 'Marco Resin' *S.B.* 26*C*, has many characteristics which make for general use in biology. *S.B.* 26*C* has a fair degree of transparency and is fortunately nearly colourless in the polymerized state. It polymerizes at ordinary temperatures without special apparatus, is completely anhydrous and is thus suitable for wet specimens. It can be used as an embedding medium in three types of mount: the wet mount, in which specimens are embedded directly from water; the cleared mount, in which soft tissues and some bones are rendered transparent; and the dry mount, which is mainly suitable for osteological and mineralogical specimens. *S.B.* 26*C* can also be used as an injection medium. Formulæ and details of the procedure for both uses of this resin are given in the paper.

British Journal for the Philosophy of Science

It seems unlikely that the present trend of scientific activities is going on unobserved by acute minds. Its characteristic feature is that the individual has largely been replaced by the team. Applied physics, for example, requires corporate effort rather than lone strife and solitary meditation. Awareness of these things has helped to bring to birth the *British Journal for the Philosophy of Science*—a quarterly which made its first appearance in May (Edinburgh and London: Thomas Nelson and Sons, Ltd. 7*s.* 6*d.*; annually, 30*s.*), in an attempt to deal with the basic, yet wide, aspects of science. That it should have started life at this particular time is significant; the need is to integrate the more profound personal problems of our generation—ethical, religious, æsthetic—into some coherent pattern congruent with experience in a scientific age. The first number sets a high standard. It contains articles on the theory of measurement, the development of the theory of science, Descartes and the mind–body problem, and metaphysical interpretations. Appropriate space is also provided for reviews. The policy of the managing committee, assisted by a distinguished editorial board, will be to publish contributions the primary datum of which is science, with particular reference to its philosophical implications. Historical aspects will not be overlooked. In view of the marked interest recently awakened at the universities of Britain in studies of this kind, the new journal should quickly find willing readers and competent contributors. That the response from authors qualified to write has, in fact, been considerable suggests that a very high level can be demanded. The founders are well aware of the tendency to fall away, and are taking every precaution to prevent it. They and their publishers are entitled to congratulations upon a brave effort, worthy of all possible support.

Vitamin K and Prothrombinæmia

In the second volume of *Publicaciones de Medicina Experimental* of the University of Chile (pp. 324; Santiago: Universidad de Chili, 1947), Dr. Ismael Canessa discusses the history, chemistry, physiology and functions of vitamin K and the symptoms and pathology and other aspects of prothrombinæmia. The paper, which is 304 pages long, occupies most of this volume. The remainder of the publication is given to a shorter paper on the level of circulatory prothrombin and the effect of splenectomy on it, with a note suggesting a chemical formula for fibrinogen.

Science and the World's Food Supply

A course on "Science and the World's Food Supply", organised by the Educational Centres Association, will be held at Westham House, Barford, near Leamington, Warwickshire, during August 26–September 2, under the general supervision of Dr. M. H. Clifford, tutor and lecturer in natural sciences, Cambridge University Board of Extra-Mural Studies. This course is designed to bring together laymen and men of science to study some aspects of the contribution that science can make to the increase of human well-being, and will deal with the application of science to the problem of increasing the world's food resources. There will be a series of evening lectures by visiting speakers dealing with the industrial and biological aspects of food processing. Members of the course will be able to make their own individual contribution to the subject at tutorial discussions, and there will be a visit to an agricultural research station. The cost of the course is £4 15*s.*, which includes board, residence and tuition. Further information can be obtained from the Summer School Secretary, Educational Centres Association, 8 Endsleigh Gardens, London, W.C.1.

Paris Congress on Electron Microscopy

A congress of electron microscopy will be held in Paris during September 14–22. It is being organised by the Société Française de Microscopie Théorique et Appliquée, and the work will be divided into five sections: electron optics and microscopes, electron diffraction, metallurgical applications, chemical applications, and biological applications. Two exhibitions are being arranged to be held during the congress, the first to illustrate the history of the development of the electron microscope, and the second to give examples of recent work with the instrument. Laboratory visits and excursions to different parts of France are also being planned. The official language of the congress will be French; but texts can be presented in English. A detailed programme can be obtained from the Congress Secretariat, Laboratoire de Cryptogamie du Muséum National d'Histoire Naturelle, 12 rue de Buffon, Paris 5e.

Summer School on the Physics and Chemistry of Free Radicals

A summer school on the "Physics and Chemistry of Free Radicals" will be held in the University Department of Physical Chemistry, Cambridge, during August 19–26. Courses of lectures and demonstrations will be given on: structure, spectroscopy and mass-spectroscopy of free radicals; free radicals produced by light and nuclear radiation and their reactions; role of free radicals in combustion and polymerization; and free radical reactions in solutions. Men can be accommodated in college rooms. Further details and forms of application may be obtained from the Secretary of the Summer School, Department of Physical Chemistry, Free School Lane, Cambridge.

University of London: Appointments

The following appointments in the University of London have been announced: Dr. E. R. Leach to the University readership in anthropology tenable at the London School of Economics and Political Science; Dr. W. L. G. Gent to the University readership in physical and inorganic chemistry tenable at Guy's Hospital Medical School; and Dr. A. T. J. Dollar to the University readership in geology tenable at Birk-

beck College. The title of professor emeritus in the University has been conferred on the following: Prof. A. J. Allmand, on his retirement from the Daniell chair of chemistry at King's College; Sir Cyril Burt, on his retirement from the chair of psychology at University College; and Prof. R. O. Kapp, on his retirement from the Pender chair of electrical engineering at University College. The title of reader in physics in the University has been conferred on Dr. O. E. H. Klemperer in respect of the post held by him at the Imperial College of Science and Technology.

University of Birmingham: Appointments

THE following appointments in the University of Birmingham have been announced: Prof. A. Boyce Gibson, professor of philosophy in the University of Melbourne, to be professor of philosophy in succession to Prof. L. J. Russell, who is retiring; Dr. S. C. Redshaw to be professor of civil engineering in succession to Prof. C. Batho, who is retiring; E. B. Edney, lecturer in zoology, to be reader in entomology; D. A. Bell, lecturer in electrical engineering, to be reader in electromagnetism; W. Carnegie, of the Pametrada Research Station, Wallsend, J. W. Railly, of C. W. Parsons and Co., Ltd., and F. E. Kras, of the Northampton Polytechnic, lecturers in mechanical engineering; Dr. R. Schneider, lecturer in experimental therapeutics.

The Night Sky in August

NEW moon occurs on August 13d. 16h. 48m., U.T., and full moon on August 27d. 14h. 51m. The following conjunctions with the moon take place: August 11d. 15h., Venus 5° S.; August 15d. 18h., Mercury 2° S.; August 15d. 20h., Saturn 1° N.; August 19d. 04h., Mars 3° N.; August 27d. 12h., Jupiter 1° N. In addition to these conjunctions with the moon, Mercury is in conjunction with Regulus on August 1d. 11h., Mercury 0·5° N., and on August 16d. 22h. Mercury is in conjunction with Saturn, Mercury 3·5° S. Mercury sets less than an hour after the sun on August 1 and attains its greatest eastern elongation on August 21; the planet is too close to the sun for favourable observation during the greater portion of the month. Venus rises about two hours before the sun throughout August and is conspicuous during the early morning hours, more than nine-tenths of the illuminated disk being visible through the greater part of the month (stellar magnitude −3·3). Mars sets at 22h. on August 1 and 20h. 40m. on August 31, and is drawing rather close to the sun after this for favourable observation. Jupiter rises soon after sunset and is visible throughout the night in the constellation of Aquarius; the planet is in opposition on August 26. Saturn sets at 21h. 10m. on August 1 and is too close to the sun for favourable observation during most of the month. Occultations of stars brighter than magnitude 6 are as follows: August 7d. 03h. 41·5m., 23 Taur. (*D*); August 30d. 23h. 48·4m., ε Pisc. (*D*); Aug. 31d. 00h. 49·1m., ε Pisc. (*R*). *D* and *R* refer to disappearance and reappearance respectively, and the latitude of Greenwich is assumed.

Announcements

PROF. F. C. STEWARD, professor of botany in the University of Rochester, New York, formerly lecturer in Birkbeck College, London, has been appointed a professor of botany in Cornell University as from September 30.

DR. S. A. BARKER, of the University of Birmingham, has been appointed Mackinnon Research Student of the Royal Society. He will work on the enzymic synthesis of polysaccharides.

MR. L. M. JACKMAN (University of Adelaide) has been elected to a Beit Fellowship for scientific research of the value of £500 per annum, tenable at the Imperial College of Science and Technology, for research in organic chemistry under the direction of Prof. R. P. Linstead.

MR. D. G. GILLAM (University of Melbourne) has been awarded an Overseas Science Scholarship by the Royal Commission for the Exhibition of 1851, in place of Mr. L. M. Jackman, who has accepted a Beit Fellowship (see above). Mr. Gillam will carry out research in physical chemistry at the Royal Institute of Technology, Stockholm.

THE Committee of the Privy Council for Agricultural Research and Nature Conservation has reappointed Mr. T. Dalling and Dr. Joseph F. Duncan to be members of the Agricultural Research Council for a further term, and have also appointed Prof. S. C. Harland to be a member in the vacancy caused by the retirement from the Council of Sir David Brunt.

MR. ARTHUR MASON, formerly a textile consultant in London, has been elected an honorary life member of the Textile Institute.

IT is announced by the University of Leeds that Mr. A. F. Maloney has been appointed to the newly instituted post of lecturer in neuropathology; and Mr. B. W. Wyke has been appointed lecturer in physiology. Messrs. Brotherton and Co., Ltd., have renewed for seven years their gift of £1,000 a year for maintaining a research lecturer and research assistant in chemical engineering in the University.

THE Society of Physical Chemistry proposes to organise annually a meeting of several days duration for the discussion of a specific topic. In 1951, the meeting will take place in May, and the topic will be "Transferts électroniques en solutions et aux électrodes". Titles of communications must be submitted before December 31, 1950, and the complete papers by February 15, 1951. Further information can be obtained from the Secretary, Dr. G. Emschwiller, École Supérieure de Physique et de Chimie, 10 rue Vauquelin, Paris (5e).

THE ninth General Assembly of the International Union for Geodesy and Geophysics will be held in Brussels during August 21–September 1, 1951. The provisional programme includes a symposium on the study of the ocean bottom, and joint meetings of different sections to discuss the physics of the upper atmosphere and ionosphere; general circulation of the oceans and the atmosphere; movements of the earth's crust; and nature of the earth's core

THE New Zealand Council of Scientific and Industrial Research is offering a postgraduate scholarship to enable a British graduate in science or engineering to spend two years in the Dominion. Hitherto, New Zealand students have come to Britain; but it is believed that the natural resources and climatic conditions of New Zealand provide unusual opportunities which would appeal to an overseas student. Particulars can be obtained from the New Zealand Scientific Office, Africa House, Kingsway, London, W.C.2.

CONFIGURATION OF CARBOHYDRATES, HYDROXY-ACIDS AND AMINO-ACIDS

Stereochemical Standards of Configuration

THE agreed standard by reference to which configurations are expressed in the carbohydrate and hydroxy-acid series is glyceraldehyde, the (+)-form of which is 'D' by definition. By the use of transformations which do not change any bond of the asymmetric carbon atom, it has been shown, for example, that (+)-tartaric acid, (+)-malic acid, (−)-lactic acid, and (−)-glyceric acid all correspond in configuration to (+)-glyceraldehyde. It follows that all are D-compounds on the glyceraldehyde standard.

The agreed standard of reference for the expression of configurations in the series of peptides and amino-acids is serine, the (−)-form of which (the 'natural' form) is 'L' by definition. By the use of reactions which do not break a bond at the asymmetric centre, it has been shown, for example, that (+)-alanine, (−)-asparagine, (−)-cystine, (+)-valine and (−)-tyrosine agree in configuration with (−)-serine. It follows that all are L-compounds on the serine standard.

The question of the relationship between these two standards has engaged attention. It has been made plausible by arguments from molecular rotations, and assumed chemical analogies, that the standards agree[1–4]. But it has been emphasized that such arguments are not conclusive[3,5]. For this reason it has become conventional to specify the standard employed, whenever there could be any doubt, by means of the subscripts 'G' and 'S' (meaning glyceraldehyde and serine) in designations such as 'D_G' and 'D_S'.

Clearly, it would be convenient if the two standards could be firmly connected, especially in view of the extensive merging, for example, in amino-sugars, of the carbohydrate and amino-acid fields of investigation, and because of the frequent need for expressing configurations about more than one asymmetric centre. We are indebted to Dr. A. Neuberger for directing our attention to this problem, and to Dr. R. S. Cahn for much further information emphasizing its general importance. As a direct consequence of these conversations, we realized that we had in our unpublished records the result needed for its solution.

In his recent review[3] of the stereochemistry of amino-acids, Neuberger discusses the problem of correlating the two standards; and he points out that this problem could be solved by our kinetic method. Actually we have solved it in this way, as is recorded in summary below.

The method is based on the well-established principle[6] that, independently of all structural details, bimolecular nucleophilic substitution leads to inversion of configuration. In applying the method, the chief task always is to prove kinetically that such substitutions at an asymmetric centre as are involved in the establishment of a genetic connexion between given optically active substances are, indeed, bimolecular nucleophilic substitutions (S_N2).

There are five stages, most of them composite, in the genetic route between glyceraldehyde and serine. They are indicated in the following scheme, which also shows the configurationally corresponding signs of rotation of the different substances (the symbol ∼ means 'corresponds in configuration to'):

(+)-glyceraldehyde ∼ (−)-glyceric acid (1) ∼ (−)-lactic acid (2) ∼ (+)-α-bromopropionic acid (3) ∼ (−)-alanine (4) ∼ (+)-serine (5).

Stages (1), (2) and (5) were covered by work which is now classical: the method was always to modify groups without breaking a bond at the asymmetric centre. Stage (3) was covered by Cowdrey, Hughes and Ingold during the development of the kinetic method. The whole road between glyceraldehyde and serine is now opened by the completion of stage (4). The stages are described in historical sequence.

Stage 5. Fischer and Raske (1907) converted (−)-serine into (+)-alanine as follows[7]:

$$\begin{array}{l} CH_2.OH \\ | \\ CH(NH_2).CO_2H \end{array} \xrightarrow[\text{hydrochloride}]{PCl_5 \text{ on ester-}} \begin{array}{l} CH_2Cl \\ | \\ CH(NH_2).CO_2Me \end{array} \xrightarrow[\text{reduced}]{\text{free acid}} \begin{array}{l} CH_3 \\ | \\ CH(NH_2).CO_2H. \end{array}$$

Stage 2. Freudenberg (1914) converted (−)-malic acid, through *iso*serine, (*a*) into (+)-glyceric acid, and (*b*) into (+)-lactic acid[8]:

$$\begin{array}{l} CH_2.CO_2H \\ | \\ CH(OH).CO_2H \end{array} \xrightarrow[\text{amide}]{\text{via half-}} \begin{array}{l} CH_2.NH_2 \\ | \\ CH(OH).CO_2H \end{array} \begin{array}{l} \xrightarrow{HNO_2} \text{glyceric acid} \\ \xrightarrow{NOBr} \beta\text{-bromo-acid} \xrightarrow{NaHg} \text{lactic acid.} \end{array}$$

Stage 1. Wohl and Schellenberg (1922) converted (+)-glyceraldehyde into (−)-glyceric acid by direct oxidation with mercuric oxide and alkali[9].

Stage 3. Cowdrey, Hughes and Ingold (1937) converted (+)-α-bromopropionic acid into (+)-lactic acid by alkaline hydrolysis under conditions which were kinetically controlled to secure an S_N2 reaction, that is, an inversion of configuration[10].

Stage 4. We have converted (+)-α-bromopropionic acid into an α-azidopropionic acid by reaction with sodium azide under conditions which were kinetically controlled to yield an S_N2 reaction (k_2 in water at 50·0°, $8{\cdot}29 \times 10^{-4}$ sec.$^{-1}$ gm.-mol.$^{-1}$ l.), and therefore an inversion of configuration. Then we reduced the azido-acid by Adams's method to (+)-alanine, a process which does not break any bond at the asymmetric centre, and accordingly must retain configuration. The overall result must therefore be inversion. The same overall result was obtained by proceeding through the methyl ester of (+)-α-bromopropionic acid and the corresponding azido-ester. Experimental particulars will be published later.

This completion of this genetic chain between glyceraldehyde and serine establishes the relations

$D_G \sim D_S$ and $L_G \sim L_S$; that is, the two standards agree.

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[1] Frankland, *J. Chem. Soc.*, 713 (1933).
[2] Freudenberg, "Stereochemie", 317 (1933).
[3] Neuberger, "Advances in Protein Chemistry", **4**, 297 (1948).
[4] Wolfrom, Lemieux and Olin, *J. Amer. Chem. Soc.*, **71**, 2874 (1949).
[5] Lowry, "Optical Rotatory Power" (1925).
[6] Cowdrey, Hughes, Ingold, Masterman and Scott, *J. Chem. Soc.*, 1252 (1937).
[7] *Ber.*, **40**, 3717 (1907).
[8] *Ber.*, **47**, 2027 (1914).
[9] *Ber.*, **55B**, 1404 (1922).
[10] *J. Chem. Soc.*, 1208 (1937).

Configurations of Amino-Compounds and the Steric Course of Deamination

IT was shown in 1937[1] that a Walden inversion could be firmly located in a series of chemical changes, that sign of rotation could be connected with configuration, and that the incidence of Walden inversions generally could be reduced to rule, by consideration of the two kinetically distinguishable mechanisms, S_N2 and S_N1, of aliphatic substitution, which had been recognized somewhat earlier. The rules for the steric course of substitution were as follows:

S_N2. Substitution by this mechanism involves inversion of configuration, independently of all constitutional details. This rule, which has theoretical as well as experimental justification, is so definite that it can conveniently be used in order to relate sign of rotation to configuration.

S_N1. This mechanism proceeds through a carbon cation, and involves racemization, possibly with some excess of inversion, unless a configuration-holding group, such as the α-carboxylate ion group, is present, when configuration is retained. Winstein has since shown[2] that suitably situated neutral groups with active unshared electrons can similarly lead to a preserved configuration. Dr. A. G. Davies has recently found[3] that even double-bond π-electrons can exert an effect in the same direction.

The classical work on the Walden inversion related mainly to interconversions between the following three types of compound: (*a*) *R*Cl, *R*Br; (*b*) *R*OH, *R*OAlk; (*c*) RNH_2. The above rules were applied in 1937 entirely to interconversions between compounds of types (*a*) and (*b*). We have now applied them to interconversions between either of these series and series (*c*). This allows us to relate the signs of rotation of amines to their configurations, and thus to interpret with certainty the stereochemical course of many transformations which form or destroy amino-compounds.

The first step was to establish the relation of sign of rotation to configuration for a representative series of amines by the use of the above S_N2 rule. This was done with reference to the corresponding halides, by the general method exemplified in the preceding note:

$$R\text{Hal} + N_3^- \xrightarrow[\text{controlled } S_N2]{\text{kinetically}} RN_3 \xrightarrow[\text{Pt}]{H_2} RNH_2 \text{ (overall inversion).}$$

The work of 1937 established the relation of sign of rotation to configuration for the corresponding alcohols and ethers, with respect to the halides. Therefore the new work extends the correlation over the three series, (*a*), (*b*) and (*c*). Configurational correspondence has thus been proved, *inter alia*, within each of the following sets of compounds, *RX*, with the same *R* and variable *X* (C_6H_{13} means *n*-hexyl):

RX	*X* = Cl	Br	OH	OEt	NH_2
$C_2H_5.CHX.CH_3$	(+)	(+)	(+)	..	(+)*
$C_6H_{13}.CHX.CH_3$	(+)	(+)	(+)	(+)	(+)*
$C_6H_5.CHX.CH_3$	(+)	(+)	(+)	(+)	(+)*
$CH_3.CHX.CO_2H$	(+)	(+)	(−)†	..	(−)
$C_6H_5.CHX.CO_2H$	(+)	(+)	(+)	..	(−)

* Rotations refer to the pure liquids.
† These hydroxy-acids have (+)-salts.

The next step was to examine the rotatory changes which accompany deamination of each of the above amines. Relevant work on the amino-acids is already on record[4], but very little significant work on the amino-hydrocarbons has been reported. In supplementing the available data, we have examined the following deamination processes (the second of which has been but little studied hitherto):

RNH_2 +	HNO_2	+ acid	+ H_2O	— →	*R*OH
" +	"	+	+ EtOH	— →	*R*OEt
" +	NOCl	+ HCl	+ H_2O	⟶	*R*Cl
" +	N_2O_3 or NOCl	+ HBr	+ "	⟶	*R*Br

After translating the observed rotations into terms of configuration with the aid of the results noted above, the outcome of this work can be reduced to the following summary (In = inversion, Rt = retention of configuration, Rac = racemization):

Factor (RNH_2)	Product *R*OH	*R*OEt	*R*Cl	*R*Br
$C_2H_5.CH(NH_2).CH_3$	Rac+In	..	Rac+In	Rac+In
$C_6H_{13}.CH(NH_2).CH_3$	Rac+In	Rac+In	Rac+In	Rac+In
$C_6H_5.CH(NH_2).CH_3$	Rac+In	Rac+In	Rac+In	Rac+In
$CH_3.CH(NH_2).CO_2H$	Rt	..	Rt	Rt
$CH_3.CH(NH_2).CO_2Et$	..	..	..	Rac+In
$C_6H_5.CH(NH_2).CO_2H$	Rt+Rac	..	Rt+Rac	Rt+Rac

Racemization was always especially extensive in the reactions of the phenyl compounds, just as was found in the work of 1937 on the S_N1 substitutions of halides.

This table makes it quite clear that deamination in all its forms is obeying the above-mentioned S_N1 rule. It follows that the last steps of deamination must have the form of an S_N1 process, involving a carbon-cationic intermediate, a conclusion which accommodates the frequent observation of Wagner-type rearrangements during deamination (pinacolic deamination, Demjanov reaction, etc.):

$$RNH_2 \rightarrow RNH.NO \rightarrow \underbrace{RN_2^+ \rightarrow R^+ \rightarrow RX}_{S_N1}$$

Pursuing this conclusion, it is possible, by use of the S_N1 rule, unambiguously to assign to most of the singly asymmetric amino-compounds that have been deaminated, configurations relative to those of the corresponding halogeno-compounds and alcohols. An equivalent statement is that the steric course of all those reactions which have been used either to produce the amino-compounds or to deaminate them can be considered known. For illustration, configurational correlations, thus deduced, for a few more amino-acids are as follow:

RX	X			
	Cl	Br	OH	NH_2
$(CH_3)_2CH.CHX.CO_2H$	..	(+)	(−)†	(−)
$(CH_3)_2CH.CH_2.CHX.CO_2H$	..	(+)	(+)	(+)‡
$C_6H_5.CH_2.CHX.CO_2H$	..	(+)	(+)	(+)
$CO_2H.CH_2.CHX.CO_2H$	(+)	(+)	(+)	(+)‡
$CO_2H.CH_2.CH_2.CHX.CO_2H$	(+)	..	(+)	(−)

† These hydroxy-acids have (+)-salts.
‡ These amino-acids have (−)-cations in aq. HCl.

Kinetic and optical details of this work will be published elsewhere.

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[1] Cowdrey, Hughes, Ingold, Masterman and Scott, *J. Chem. Soc.*, 1196, *et seq.* (1937).
[2] Winstein, *et al.*, many papers since 1939 in *J. Amer. Chem. Soc.*
[3] Davies, Thesis, London (1949).
[4] Fischer and Skita, *Z. physiol. Chem.*, **33**, 190 (1901); Fisher and Warburg, *Ber.*, **40**, 489 (1907); McKenzie and Clough, *J. Chem. Soc.*, **95**, 777 (199).

BIOLOGY OF ADULT MOSQUITOES IN EASTERN COLOMBIA

By DR. JULIAN de ZULUETA

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THE necessity for a better understanding of the behaviour in Nature of adult mosquitoes has become of increasing importance for malaria control work, since the main stress of recent campaigns has been laid on the destruction of the adult anophelines as the best means of breaking up the malaria cycle. Unfortunately, our present knowledge of mosquito biology has been derived mainly from larval studies and observations on the aquatic habitat of mosquitoes, their terrestrial life being more difficult to approach than their aquatic phase of development. This knowledge has proved repeatedly to be inadequate in explaining the changes suffered by natural mosquito populations. Such has been our experience in Villavicencio[1], where the variations in mosquito density and the changes in species composition observed during the year could not be explained by a study of the larval life of the local mosquito species.

In a recent publication[2], we were able to demonstrate the feasibility of a close study of the life of the adult mosquito in a savanna country like the 'llanos' or plains of eastern Colombia. By means of the simple techniques evolved, it was found that the grass of the savannas is not only a diurnal resting place but also the true habitat of several mosquito species. Records were obtained of mosquito density, dispersal from breeding places and effective flight range. This last proved to be of about one mile, a considerable distance to be flown by a species in effective numbers; but we thought that the females covering such distances were not crossing the savannas attracted by an animal source of blood. It was our impression that there were, in fact, two different kinds of flight: a long flight of dispersal from the breeding areas, and another flight of much shorter range towards the source of blood.

Experiments carried out later have shown that cutting the grass, where the savanna mosquitoes rest during the day-time and over which they fly at night, produces a great drop in the number of mosquito females coming to bite. Most of the experiments were made with stable traps baited with donkeys, using two identical traps in every experiment; one was set up in the middle of a clearing and the other in the savanna at about 100 m. from the edge of the clearing. Mosquito captures were made simultaneously, the number of females caught in the uncleared area being used as control. Though the donkeys were of approximately the same size and bulk, to avoid any possible difference in their relative attractiveness, they were exchanged in every experiment.

In a series of eleven trials, 20,884 mosquito females were captured, their distribution being as follows:

	Cleared area	Control area
Anophelines	608	3,698
Culicines	6,679	9,899

The deterrent effect of getting rid of the grass was much more marked in the case of the anophelines than in the case of the culicines. The anophelines caught in the cleared area were only 14 per cent of the total number of anophelines captured, but the culicines captured in the clearing amounted to 40 per cent of the total number caught. The clearings were of circular shape, the radius varying from 10 to 50 m. In the experiments made with clearings of 50 m. radius, the anophelines entering the stable trap in the cleared area were only 8 per cent of the number captured in these experiments. In all the trials mentioned above, samples of anophelines were taken at random and identified, and it was noticed that the species composition was very much the same for both the cleared area and the control area. A total of 1,053 specimens were identified with the following results:

	Anopheline species (per cent distribution)				
	A. pessoai	*A. peryassui*	*A. parvus*	*A. darlingi*	Miscellaneous
Cleared area	72	22	2	3	1
Control	60	36	3	1	—

Two trials made with human dwellings gave similar results. Clearings of roughly 70 m. radius were made around two peasant huts in which the mosquitoes coming to bite gave an average of 39 mosquitoes per night before the destruction of the grass. No mosquitoes were captured during the two nights after the clearing was made. Though this is too small a sample from which to draw any definite conclusions, it shows nevertheless that this simple method deserves further attention from the practical point of view of malaria control. It may be added that all the experiments mentioned here were carried out in endemic areas in which *A. darlingi*, one of the chief malaria vectors of the neotropical region, was present.

The difficulty encountered by the blood-seeking females in reaching the baited trap or the human dwelling in the middle of the clearing could be interpreted either as a failure of the females to detect

the bait within the cleared area, or as due to the repellent effect that a bare surface of ground may have on species living in the grass. We are inclined to believe that the first explanation is correct. In the course of our studies on mosquito density we have found that, when the continuity of the savannas is broken by an area devoid of grass, such as a road, the numbers of mosquitoes found on both sides of the clearing are practically the same. In one of our study areas a track made by motor traffic leaving a bare surface of ground 20–30 m. wide produced a clear cut across an expanse of savanna. On one side was left a wide area of savanna with numerous breeding places, on the other side no breeding places were found. The mosquitoes caught resting in the grass must have come across the track, since no suitable breeding place for savanna mosquitoes could be found in the great forest framing this side of the savanna. Using the technique already described[2] for catching resting mosquitoes, it was found that the mosquito density on the forest side was 3·6 mosquitoes per sq. m. of ground, and on the open side 2·7 mosquitoes per sq. m. This shows in the first place that 20 or 30 m. of bare ground, deterrent as they would be to blood-seeking females, have no effect on mosquitoes dispersing over the savannas; also that the density of mosquitoes tends to be higher away from the breeding places than in their vicinity, which is in agreement with our previous findings[3].

If the culicines have less difficulty in reaching the bait in a cleared area, this is probably due to their being better able to detect it and being also better fliers. In our previous studies[2] we found that the flight-range of dispersal among male anophelines was shorter than the corresponding range of the male culecines. Our present observations seem to point to a shorter range of flight in the blood-seeking anophelines than in the blood-seeking culicine females. A preliminary study on the altitude of flight among the savanna mosquitoes has shown that the culicines usually fly at a higher level than the anophelines. This may account for their greater aptitude for covering wide areas in their dispersal flight and in reaching an animal source of blood, the savanna anophelines flying too near the grass to range as freely. Data on flight-levels were obtained using muslin nets fixed to a moving vehicle, following the technique already described[2]. Two nets were used simultaneously, one fixed at 1·5 m. above the ground, just above the tops of the flowering stems of grass, the other at 4·5 m. above the ground. 3,505 specimens were captured in nine trials, the distribution being as follows:

	1·5 m. above the ground		4·5 m. above the ground	
	Males	Females	Males	Females
Anophelines	125	161	139	16
Culicines	495	607	1,858	104

Males fly higher than the females of their genus, but culicines taken as a whole tend to fly at a higher level than anophelines. It is curious to observe that such difference in distribution could be detected with a difference in altitude of only three metres. It is worth mentioning here that the vertical distribution of mosquitoes in a forest varies considerably with a small difference in altitude. The stratification of forest mosquitoes was demonstrated for the first time in Villavicencio. In the course of epidemiological studies of jungle yellow fever, Dr. Boshell was able to prove that the vector in the forest, *Hœmagogus spegazzinii*, could be found only in the upper part of the undisturbed forest[3]. Later, Dr. M. Bates proved that this zonal distribution applies not only to this species but also to many other mosquitoes living in the forest[4]. The present observations show that the stratification of flying mosquitoes is not limited to the forest but can be found also in a savanna country. A full report on the characteristics of flight of the savanna mosquitoes will be published elsewhere.

[1] Bates, M., and de Zulueta, J., *Amer. J. Trop. Med.*, **29**, 129 (1949).
[2] de Zulueta, J., *Amer. J. Trop. Med.*, **30**, 325 (1950).
[3] Bugher, J. C., Boshell-Manrique, J., Roca-García, M., and Osorno-Mesa, E., *Amer. J. Hyg.*, **39**, 16 (1943).
[4] Bates, M., *Ecology*, **25**, 159 (1944).

THE HEALTH OF ENGLAND AND WALES

THE report of the Ministry of Health for the year ended March 31, 1949, which includes the report of the chief medical officer, Sir Wilson Jameson, for the year 1948*, shows that 1948 was remarkable in the history of health in England and Wales. Apart from the inauguration during that year of the National Health Service, the celebration of the centenary of the passing of the first Public Health Act, and the final disappearance of the Poor Law system, the total death-rate in 1948 was 10·8 and the civilian death-rate was 11·0 per thousand, both of which are the lowest figures on record. Compared with 1938, which showed the lowest standardized mortality of any year before the Second World War, the comparative mortality index at all ages showed a decline of twenty per cent. For a year of economic struggle, this is a remarkable record. Climatic influences no doubt helped, because the winter, spring and autumn were warm, and there was no epidemic of influenza; but the many facets of public health activity recorded in these reports show that, whatever the effects of the weather may be at any time, the constant, watchful efforts of many experts are always serving the public quietly, effectively and without publicity.

A valuable feature of the report of the chief medical officer is its analysis of the vital statistics for the years 1938–48. This shows that, among the principal causes of death, the most striking falls during this ten-year period occurred in the death-rates from influenza, enteritis and diarrhœa, and that there were remarkable reductions in the numbers of deaths from cerebrospinal fever, diphtheria, nervous diseases, bronchitis, pneumonia and infantile diseases, while the death-rates from measles and whooping cough fell to new low levels. Deaths from cancer, however, increased, especially among males, who suffered more from cancer of the respiratory system. The birth-rate rose; but infantile mortality fell.

The epidemiological feature in England and Wales for 1948 was the absence of epidemic influenza, and no smallpox occurred in the country. There was, however, after the repeal of the Vaccination Acts in 1946, an alarming decline in vaccinations of infants; Sir Wilson Jameson gives warning that immunity to smallpox in England and Wales is now dangerously low, and he directs attention to the section of the report which deals with this subject.

* Report of the Ministry of Health for the Year ended 31st March 1949, including the Report of the Chief Medical Officer on the State of the Public Health for the Year ended 31st December 1948. (Cmd. 7910.) Pp. xvi+374. (London: H.M. Stationery Office, 1950.) 7s. 6d. net.

The chapter dealing with immunization against diphtheria demonstrates, on the other hand, the beneficent effects of the fight against this disease. They are shown by the reduction of notifications of diphtheria and deaths from it to less than one-tenth of those recorded in the years before immunization. Reduction in the fatality-rate of scarlet fever was partly due to penicillin and the sulphonamide drugs and partly to a natural cyclic fall in the virulence of the streptococci which cause this disease. Measles was more prevalent in 1948 than in the previous year; but there were only 327 deaths from it. Trials of a prophylactic serum against measles were in progress. As many parents know, whooping cough was also prevalent in 1948; but the fatality-rate (0·51 per cent) was lower than in any other year. This disease is, however, still a prominent cause of the deaths of infants. It is especially dangerous during the first year of life and particularly during the first six months. Although special efforts are being made to find a drug to treat it, to improve methods of diagnosis and to make an effective prophylactic vaccine, the protection of infants from infection remains, at present, the best method of fighting the disease.

The incidence of cerebrospinal fever was low and sporadic; but notifications of poliomyelitis continued during the early part of 1948 at a high rate after the epidemic of 1947 and caused much anxiety. The extensive work on typhoid fever, paratyphoid fever, dysentery, enteritis and other diseases of the alimentary canal is described in some detail. That landmark in the battle of man against malaria, namely, the discovery by workers at the London School of Hygiene and Tropical Medicine of the phase of the malarial parasites which lives and multiplies in the human liver before the parasites enter the blood cells, receives the attention it deserves. Some diseases, such as anthrax and leprosy, are rare but demand a great deal of administrative labour and care. The marked fall in the incidence of syphilis recorded in 1947 continued during 1948, although it has been less marked in the large seaports, and considerable reservoirs of this disease still exist in England and Wales. The incidence of gonorrhœa has also fallen; but it is likely that many women are infected without knowing it.

The number of deaths due to cancer increased, partly because there were more people living at the ages most susceptible to this disease. It increased more in males than in females, and two-thirds of the male increase was due to cancer of the respiratory system. An interesting section of the report deals with acute rheumatism in children less than sixteen years of age and with chronic rheumatism. Other sections deal with the continuing expansion of the Public Health Laboratory Service, with outbreaks of milk-borne typhoid fever, paratyphoid fever and scarlet fever, with the Hospital Laboratory Service and the National Blood Transfusion Service, and with tuberculosis, mental disease, hospital planning and the dental services.

A survey of nutrition reports little change in the good nutritional state of school children and records satisfactory hæmoglobin levels among housewives and expectant mothers. As is well known, the treatment of flour by the 'agene' process has now ceased. The report leaves the reader in no doubt that nutrition, which is so important a means of combating disease of all kinds, is being studied in all its aspects. Not less important is the continued difficulty in providing the nursing and other staff for hospitals, and a chapter is devoted to this acute problem. The report of social survey workers describes some of the methods employed and records no real difference in the amounts of sickness recorded in 1947 and 1948. Another chapter deals with the first World Health Assembly in June 1948 and the international health work arising out of it.

In the second section of the report, the administration of the national health and welfare services are considered, and Part 2 discusses housing, local government, water, river boards and sewerage and its disposal. There are fourteen appendixes which add useful information to the great store of facts recorded in this combined report. It is, as Sir Wilson Jameson says, the work of many hands and is a monument to the effort and care expended upon the many aspects of the national health. The nation's gratitude is due to all these men and women who labour continually on its behalf. Whether their jobs are the humbler ones of the nurse or the clerk, or the more responsible ones of the expert, they constitute together a remarkable team. Sir Wilson Jameson, who retired early in 1950[1], has played a great part in building up and co-ordinating their efforts and can look back on a fine record during his term of office. He pays a fine tribute to Sir George Newman, who died in 1948[2] and who, as a predecessor in office to Sir Wilson, had guided public health activities for a quarter of a century.

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[1] *Nature*, **165**, 753 (1950).
[2] *Nature*, **161**, 1001 (1948).

RESEARCH AND DEVELOPMENT AT BAKELITE, LTD.

ON June 21, Bakelite, Ltd., opened their new research and development laboratories at Birmingham to a representative gathering of those interested in both the scientific and industrial progress of high-polymer science and technology. Although only part of the manufacturing site of this concern is located at Tyseley in Birmingham, the research and development activities of the firm are mainly centred there. The visit presented a unique opportunity for seeing how one of the old-established branches of the industry has developed on the industrial side, and how, with the advance of knowledge in the science of high polymers, that science has been integrated with technology—a first pre-requisite of a healthy and forward-looking industry.

One of the major activities concerns the thermosetting resins derived from phenols and formaldehyde and from urea and formaldehyde. In spite of the extensive use of such resins in a host of applications such as laminated materials for electrical purposes, cements and adhesives, moulding powders and oil-soluble resins for paints, the chemical process involved in the manufacture of the resin as such is to a very large extent built on empirical knowledge. That does not mean that precise methods of the control of processes and the checking of the quality of the product are not used at every stage. In fact, the visit demonstrated clearly just how much can be contributed by instrumentation to the reproducibility and efficiency of the manufacturing processes employed. The older autoclaves or 'stills', as they are called, were devoid of control devices, and the whole success of synthesis depended to a large extent on the skill of the operators. In the most up-to-date

stills much of the human factor has been replaced by devices to ensure that the cycle of events in such a batchwise process is accurately reproduced time and again, so that the structure and molecular size of the resin may be kept within defined limits. There could be no better demonstration for advocates of the more extensive use and also development of instruments for application in industrial chemical processes.

The reason for the empirical development of the method of synthesis of such polymers was simply due to the fact that, forty or fifty years ago, academic interest in these matters was negligible. Indeed, it is true to say that empiricism was the only method of approach, but it has carried the industry a long way. With the considerable growth of purely scientific interest in high polymers, it was evident that the time had come for a closer integration of science and technology in the hope that science will help the technologist to achieve even greater development and exploitation of plastic materials. This is primarily the reason for the building and equipping by Bakelite, Ltd., of the first stage of research and development laboratories, to carry the above-mentioned ideas as rapidly as possible into practice.

The new building is a steel-framed construction with cavity-brick walls of a pleasing shade. Inside, the walls are plastered and furnished with cream paint. Heating is by a hot-water system supplied from an automatically controlled oil-fired boiler. The services are carried along the corridors in ducts with easy access. In the laboratories, ducts in the floors at suitable intervals provide for flexibility in the partitioning of benches and in the erection of special apparatus. Exhaustion of fume cupboards is by individual fans. Many of the furnishings—doors, library shelving, etc.—utilize resin-bonded laminated wood veneers to good effect. Laboratory benches, cupboards and wood-block flooring are constructed by the less-expensive conventional methods in hard wood. The laboratories have high ceilings, and the fixed benches are well spaced so that large-scale laboratory apparatus may be easily erected. Windows are of large area and the sills are high, so that benches with shelves can easily be fitted below the sills. Fluorescent lighting of high intensity is fixed to the ceiling, which is covered with asbestos sound-insulating material. Non-structural partitions and also metal–glass partitions make for the maximum internal flexibility of laboratory arrangement.

On the research side, a considerable volume of work is being carried out on the mechanism of the phenol–formaldehyde condensation process itself, in order to give a complete picture of the mechanism of the reaction and of the precise structure of the intermediates as well as the final products of synthesis. There was exhibited a whole range of intermediate products synthesized by rational organic methods. Similarly, methods of molecular distillation have enabled some of these intermediates to be isolated from reaction mixtures similar to those used on the large scale. Since the number of isomers present can be very large, owing to the existence of three reactive positions in the phenol molecule, infra-red and ultra-violet and spectroscopic methods are being used for structure determination. Careful studies are also being made of the kinetics of the reaction, often with the above-mentioned specially synthesized intermediates, so that the complexities of the process may be sorted out stage by stage and a closer insight gained into the various stages of this very complicated polycondensation process.

Closely associated with the fundamental research is the development side, which is fully equipped with small-scale apparatus to explore the ever-widening application of existing materials in all directions and in investigating eventually the potentialities of new materials. The facilities for evaluating the mechanical and electrical behaviour of all materials are available to the research and development departments.

There is thus added another unit to industrial research in Great Britain which will ensure that science is applied to the maximum profitable extent to an industry which might well have become traditional and wholly empirical in character, had those in charge not realized the vital necessity of bringing in the fundamental scientific approach at all stages.

SOUTH WESTERN NATURALISTS' UNION

ANNUAL CONFERENCE

THE South Western Naturalists' Union held its twenty-third annual conference at Marlborough, Wiltshire, during May 26–29, by invitation of the Marlborough College Natural History Society. Members attending the conference (about seventy) were received by the Master of Marlborough College, Mr. F. M. Heywood, in the Science Building, Marlborough College, on the evening of May 26, after which Mr. W. E. V. Young lectured on "Avebury Stone Circle". This lecture, which is to be known as the Pedler Lecture, had been financed by the British Association for the Advancement of Science from the Pedler Fund.

On the morning of May 27 a number of short talks were given by Mr. L. G. Pierson, Mr. C. R. M. Prentice, Mr. F. H. P. Barber and Mr. H. J. Killick on the birds, Lepidoptera, geology and botany of the region. On the evening of May 28, in the Memorial Hall, Marlborough College, Mr. Peter Scott, president of the Union, gave his presidential address, his subject being "Nature Reserves and their Functions, with Special Reference to the Severn Wild Fowl Trust". The address was illustrated by coloured films.

The general meeting of the Union took place on May 29, at which Mr. A. O. Rowden put forward the following resolution: "This Annual General Meeting of the South Western Naturalists' Union embracing eighteen societies domiciled in the South West of England in conference at Marlborough, this 29th day of May, 1950, views with apprehension and alarm the increasing tendency of various interests to act detrimentally to the natural and archæological amenities of Dartmoor and urges that it be designated a national park with the least possible delay". This resolution was carried, and the secretary was instructed to send copies to the Minister of Town and Country Planning, the chairman of the National Parks Committee and the clerk to the Devon County Council.

In a closing address, Sir Lewis Fermor, vice-president of the Union, stressed the thanks of the conference to the members of Marlborough College for the excellent way in which they had organised the general arrangements. At the conclusion of this highly successful conference Mr. Peter Scott was re-elected president for 1951.

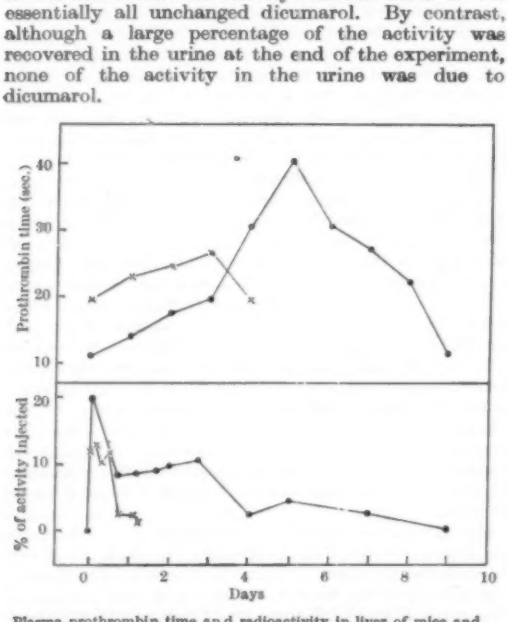
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Tracer Experiments in Mammals with Dicumarol Labelled with Carbon-14

DICUMAROL[1] is widely used clinically for the treatment of thrombosis. Since very little is known about the mechanism whereby dicumarol lowers the prothrombin-level in blood[2], it was thought that experiments with dicumarol labelled with carbon-14 might be of value. The dicumarol was prepared by adding an aqueous solution of formaldehyde containing carbon-14, obtained from the Oak Ridge National Laboratory, to a saturated aqueous solution of 4-hydroxycoumarin[3]. The 3,3′-methylene-C^{14}-*bis*(4-hydroxycoumarin) so obtained had a specific activity of 6×10^4 counts per minute per milligram, when measured with an end-window type of Geiger–Müller counter and a scale of 128.

Fourteen mice were each given 0·25 mgm. labelled dicumarol by intravenous injection. At various times after the injection, the animals were sacrificed, the tissues weighed and radioactivity determined. No significant amount of activity could be detected in the lungs, kidney and tissues in general; but large amounts of activity were found in the liver, gall bladder, fæces and urine. 80 per cent of the activity disappeared from the blood in the first hour following injection. A series of rabbits was similarly given 10 mgm. each of labelled dicumarol. A similar distribution of radioactivity was found in these animals with a rapid disappearance of dicumarol from the blood and a rapid increase of activity in the liver. By means of the isotope dilution procedure, it was shown that the activity found in the liver was essentially all unchanged dicumarol. By contrast, although a large percentage of the activity was recovered in the urine at the end of the experiment, none of the activity in the urine was due to dicumarol.



Plasma prothrombin time and radioactivity in liver of mice and rabbits after intravenous injection of dicumarol labelled with carbon-14. ×——×, mice (0·25 mgm. dicumarol); O——O, rabbits (5 mgm./kgm. dicumarol)

The rate of disappearance of dicumarol in the livers of the mice and rabbits is shown in the accompanying graph together with the changes in prothrombin time. It can be seen that, in the mice, the dicumarol remained in the liver for one day and the prothrombin-time remained high for three days, whereas in the rabbits the dicumarol remained in the liver for seven days and the prothrombin-time remained high for eight days. In further experiments, mice were injected with labelled dicumarol together with vitamin K. It was found that, for the animals receiving the vitamin, activity appeared in the liver immediately after the injection; but that in the following hours, the activity disappeared from the liver much more quickly than for the animals not receiving vitamin K.

These results demonstrate that the liver constitutes the target organ for the action of dicumarol, and they suggest that the period of time during which dicumarol remains in the liver is related to the effectiveness of this agent in interfering with the formation of prothrombin.

This work was carried out in co-operation with Mr. C. C. Lee, Mrs. R. L. Eager, Miss E. Lepp and Dr. L. W. Trevoy. We are grateful to the United States Atomic Energy Commission for supplying formaldehyde containing carbon-14, and to the National Research Council of Canada for financial assistance.

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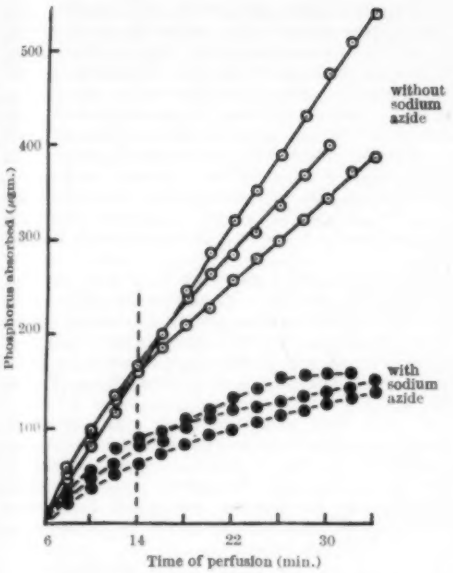
[1] Campbell, H. A., and Link, K. P., *J. Biol. Chem.*, **138**, 21 (1941).
[2] Shapiro and Weiner, "Coagulation, Thrombosis and Dicumarol".
[3] Lee, Trevoy, Jaques and Spinks, *Can. J. Res.* (in the press).

Mechanism of Absorption of Inorganic Phosphate from Blood by Tissue Cells

IN the course of a study of the phosphorus metabolism of liver, evidence was obtained suggesting that the absorption of inorganic phosphate ions from the blood is not a simple exchange of ions across the cell membrane but that it requires an energy-yielding phosphorylating mechanism. Accordingly, this hypothesis was tested by experiments in which rabbit liver left *in situ* was perfused with homologous plasma to which a small amount of carrier-free inorganic $^{32}PO_4^{3-}$ was added (2–5 μc. per litre) with or without 0·01 *M* sodium azide. The heparinized plasma, after addition of phosphorus-32 in saline, was divided into two equal volumes to one of which sodium azide was added; the two lots were used for the control and experimental perfusions, which were carried out on the liver of litter-mate animals.

The rabbits were heparinized one hour before the experiment and then were anæsthetized with nembutal and ether. The liver was prepared for the perfusion by inserting a cannula into the portal vein and tying off both the inferior vena cava above the right renal vein and the hepatic artery. A cannula was also tied into the inferior vena cava just above the diaphragm to collect the outflow from the liver. The level of the outflow was 2 cm. above the highest point of the liver, ensuring that all parts of the organ were perfused. Before the perfusion was begun, gentle pressure was applied to the liver and as much blood as possible was drawn from the outflow cannula



with a syringe to reduce the amount of blood trapped in the liver. The plasma was oxygenated before perfusion and was warmed to 38° in the reservoir.

First the blood was washed out from the liver by an initial perfusion for 6 min. at a rate of 5 ml. per min., and then the rate was slowed down to 2 ml. per min. The amounts of phosphorus-32 which disappeared from the perfusion fluid were measured at 2 min. intervals; from the known inorganic phosphorus ($^{31}P + {}^{32}P$) content of the perfusion fluid, the amount of inorganic phosphorus absorbed by the liver could then be calculated.

The accompanying graph summarizes the results obtained. By the fourteenth minute of perfusion the outflow from the liver was clear plasma uncontaminated by red corpuscles, and therefore it was assumed that after the fourteenth minute all the phosphorus-32 which disappeared from the perfusion fluid was due to absorption by the liver. The graph shows that sodium azide inhibited severely the absorption of inorganic phosphate from the plasma. The average absorption of phosphorus by the liver in the control perfusions was 14 μgm. per min. and in the perfusions with azide 3·6 μgm. per min. after the fourteenth minute of perfusion. This difference amounts to a 74 per cent inhibition.

The results were subjected to an analysis of variance, for which I am indebted to Dr. W. L. M. Perry. The analysis is shown in the accompanying table. Since, however, the mean square between animals within treatment is highly significant, this term must be used as error to test the significance of the difference between treatments. The variance ratio in this case is 18·7 and with 1:4 degrees of freedom the probability level is 0·01–0·05. It may thus be concluded that the difference between treatments is a significant one. The specific activity of the organically bound acid-soluble phosphorus in the liver (expressed as a percentage of the specific activity of the inorganic phosphorus in the perfusion plasma), when azide-containing plasma was used for the perfusion, was only 25 per cent of that when azide was omitted from the plasma. This is an additional confirmation of the results already described.

Statistical Analysis of Results shown in the Graph

Source of variation	Degrees of freedom	Sum of squares	Mean square	Variance ratio	*P*
Between treatments	1	8246·2264	8246·2264	285·0	<0·001
Within treatments	67	3584·5452	53·5007	1·85	0·001–0·01
Between animals	4	1763·6229	440·9057	15·25	<0·001
Within animals	63	1820·9223	28·9035		

Since azide is a known inhibitor of phosphorylation, the simplest interpretation of the results is that the transfer of inorganic phosphate across cell membranes requires phosphorylating reactions. The concentration of inorganic phosphorus in tissue cells is higher (about 10–12 mgm. per cent in the liver) than in the plasma (3–4 mgm. per cent) and therefore the transfer of inorganic phosphate from plasma to tissue cells occurs against a concentration gradient. This must require the expenditure of energy. It is thought that the phosphorylating reactions on the cell membrane rather than those within the cytoplasm are implicated in the transfer of inorganic phosphate from the extra- to the intra-cellular phase. It is known, for example, that the velocity of intracellular phosphorylating reactions within the muscle fibre is as high as in the liver, yet the permeability of muscle fibre to phosphate is much lower than that of the liver cell. This difference must be attributed to differences in properties of the respective cell membranes. Sacks[1] concluded also from *in vivo* studies of heart muscle that the transfer of phosphate across cell membranes requires a phosphorylating mechanism. Similar conclusions were reached in respect of yeast cells by Nickerson and Mullins[2] and by Spiegelman, Kamen and Sussman[3].

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[1] Sacks, J., Cold Spring Harbor Symp., **13**, 180 (1948).
[2] Nickerson, W. J., and Mullins, L. J., *Nature*, **161**, 939 (1948).
[3] Spiegelman, S., Kamen, M. D., and Sussman, M., *Arch. Biochem.*, **18**, 409 (1948).

Lipids of Squid Nerve

Bear, Schmitt and Young[1] have concluded that, in addition to a collagenous connective tissue investment, the giant axon of the stellar nerve of the squid, *Loligo pealii*, is also surrounded by a thin sheath rich in lipid material. This sheath, although extremely thin, is in many respects comparable to the myelin sheath of a mammalian nerve fibre. Polarization optics and X-ray diffraction studies have suggested that there is an essential unity in the ultra-structure of the lipid-containing sheath that surrounds the axon of all nerve fibres, whether vertebrate or invertebrate, myelinated or unmyelinated[2]. Little is known of the chemical nature of the lipids of this sheath in squid nerve, or of those of the axoplasm.

Table 1 shows the concentration of lipids, determined as described previously[3,4], in the entire giant fibre of the stellar nerve and in the axoplasm,

Table 1. LIPIDS OF SQUID STELLAR NERVE (mgm./100 gm. fresh tissue)

Lipid	Whole giant fibre		Axoplasm		Axon sheaths (calc.)
	Sample 1	Sample 2	Sample 1	Sample 2	
Total phospholipid	0·332	0·335	0·185	0·174	1·03
Total cholesterol	0·089	0·078	0·029	0·039	0·31
Monoaminophospholipid (phosphoglycerides)	0·282	0·238	0·146	0·160	0·74
Sphingomyelin (diaminophospholipid)	0·050	0·097	0·039	0·014	0·29

which, as Young[5] has shown, can readily be extruded. Since we were concerned with obtaining axoplasm not contaminated with sheath fragments, the technique of Steinbach[6] was employed. Each set of analyses was done on tissue from eleven to fifteen squids.

The concentration of total phospholipid, cholesterol, monoaminophospholipid and sphingomyelin was greater in the whole fibre than in the axoplasm. There can be little doubt that these lipids are concentrated in the nerve sheaths. The figures in the last column of Table 1 were calculated from the mean concentration of lipids in both the whole fibre and the axoplasm on the assumption that the axoplasm represents 82 per cent of the wet weight of the fibre[7]. The concentration of the lipids in the lipid-containing sheath itself would be many times the values calculated for the axon sheaths, since the axon sheaths are comprised chiefly of connective tissue, the lipid-containing sheath representing only a small fraction of the total (see ref. 1, Fig. 2). On the assumption that this connective tissue contains little lipid, the figures calculated for the axon sheaths give an indication of the relative amounts of lipid in the lipid-containing sheath. The figures for total phospholipid, total cholesterol and monoaminophospholipid are reasonably accurate; but the accuracy of the figure for the sphingomyelin, calculated from figures that are themselves by difference, is considerably less.

Table 2. DISTRIBUTION OF LIPIDS RELATIVE TO TOTAL PHOSPHOLIPID

	Sheaths of squid giant fibre (calc.)	Pallial nerve of squid	Whole giant fibre of squid stellar nerve	Sciatic nerve of cat
Total phospholipid	100	100	100	100
Total cholesterol	30	32	25	53
Monoaminophospholipid (phosphoglycerides)	72	71	78	61
Sphingomyelin (diaminophospholipid)	28	29	22	39
Cerebroside	—	0	0	40
Lecithin	—	43	—	12
Kephalin	—	29	—	49

Insufficient material precluded a determination of lecithin and kephalin in the giant nerve fibre and rendered a zero reading for cerebroside equivocal. However, Table 2 shows that there is also no cerebroside in the pallial or mantle connective nerve. Since the pallial nerve, the main connexion between the group of ganglia of the central nervous system and the stellate ganglion[8,9], provided more tissue, greater confidence can be placed in these analyses.

Table 2 shows the distribution of lipids relative to total phospholipid, which was arbitrarily represented as 100. The relative distribution of the lipids in the lipid-containing sheath was not greatly different from that of the pallial nerve or, incidentally, from that of the whole giant fibre of the stellar nerve. The table also gives relative figures for the sciatic nerve of the cat[4], a mammalian nerve the lipids of which are largely in the myelin sheath. Cephalopod tissue differed from the mammalian in that it contained no cerebroside, thus confirming an earlier observation of Lanfranchi[9] for the nervous system of the octopus. There was also relatively less total cholesterol and sphingomyelin and relatively more monoaminophospholipid in the lipid-containing sheath of squid nerve. For the pallial nerve a greater percentage of this monoaminophospholipid was lecithin and less kephalin.

The results reported here are in every way consistent with the view that the giant axon of the stellar nerve of the squid possesses a lipid-containing sheath. However, despite an essential unity in ultra-structure, the lipid components of this sheath would appear to differ in a number of respects from those of mammalian nerve.

This work was financed by a grant from the National Research Council of Canada and the material was collected by one of us (J. D. McC.) during the tenure of a National Research Council Summer Scholarship at the Marine Biological Laboratory, Woods Hole. Thanks are due to Dr. H. B. Steinbach for advice with the dissection.

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[1] Bear, R. S., Schmitt, F. O., and Young, J. Z., *Proc. Roy. Soc.*, B, **123**, 496 (1937).
[2] Schmitt, F. O., and Bear, R. S., *Biol. Rev.*, **14**, 27 (1939).
[3] Johnson, A. C., McNabb, A. R., and Rossiter, R. J., *Biochem. J.*, **43**, 573 (1948).
[4] Johnson, A. C., McNabb, A. R., and Rossiter, R. J., *Biochem. J.*, **45**, 500 (1949).
[5] Young, J. Z., *Proc. Roy. Soc.*, B, **121**, 319 (1936).
[6] Steinbach, H. B., *J. Cell. Comp. Physiol.*, **17**, 57 (1941).
[7] Bear, R. S., and Schmitt, F. O. *J. Cell. Comp. Physiol.*, **14**, 205 (1939).
[8] Young J. Z., *Phil. Trans. Roy. Soc.*, B, **229**, 465 (1939).
[9] Lanfranchi, E., *Arch. Sci. Biol. (Italy)*, **24**, 120 (1938).

Composition of Human Sero-Mucoprotein

RESEARCHES into the properties of the mucoprotein component of human and animal plasma have been carried out by a number of workers, among the more recent investigations being those of Rimington[1], Hewitt[2], Winzler *et al.*[3,4] and Werner and Odin[5].

The special features of this fraction, distinguishing it from the other plasma proteins, are its non-coagulability by heat, its great solubility in water and ammonium sulphate solution, and its solubility in sulphosalicylic and perchloric acids. Each of these characteristics has given rise to different methods of isolation yielding products which have different values for total nitrogen and for the ratio, hexose/total nitrogen. It must be concluded, therefore, that each method gives a material either in a different state of heterogeneity or possibly in a different stage of degradation of an indigenous protein.

The fraction responsible for the serum 'filtrate wave' on the polarograph described by Brdicka[6] in his examination of normal and cancerous sera is derived by sulphosalicylic acid deproteinization and, therefore, seems to fall into the category of mucoprotein as defined above. In connexion with work

on this and other sero-diagnostic techniques for cancer, we have isolated specimens of the mucoprotein from human serum, using both the sulphosalicylic and perchloric acid methods of isolation. The nitrogen and tyrosine contents were, respectively, 7·09 and 3·05 gm. per cent dried material, which are close to those given by Winzler *et al.*[3].

By chromatographic analysis of hydrolysates on filter paper, we have distinguished the following amino-acid components: phenylalanine, leucine and *iso*leucine, tyrosine, methionine, valine, proline, alanine, threonine, serine, glycine, aspartic acid, glutamic acid, histidine, lysine and arginine. Cyst(e)ine has been identified polarographically on the unhydrolysed material, while tryptophane and tyrosine have been distinguished by a study of the ultra-violet absorption curve. The qualitative analysis for all these amino-acids has not previously been reported, although Winzler gave the following values: cystine 0·5, tyrosine 4·2, methionine 2·1, tryptophane 1·8 gm. per cent dry weight.

The sugar components of ox sero-mucoid have been reported by Werner and Odin[5] as mannose, galactose and glucosamine. Using a similar pyridine/amyl alcohol/water mixture as solvent, we have separated and identified in the human sero-mucoid these same constituents.

After developing the colour for the amino-sugars with the Morgan and Elson reagent[7], a spot produced by a reactant with slow mobility was observed. We believe this may be attributed to a compound formed by the interaction of hexoses with lysine or other amino-acids which has been described by Horowitz *et al.*[8].

Work on the quantitative analysis of human sero-mucoprotein derived from human normal and cancer serum is proceeding for the amino-acid and sugar components.

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[1] Rimington, C., *Biochem. J.*, **34**, 931 (1940). Rimington, C., and Staub, A. M., *Biochem. J.*, **42**, 5 (1948).
[2] Hewitt, L. F., *Biochem. J.*, **31**, 1534 (1937); **33**, 1497 (1939).
[3] Winzler, R. J., Devor, A. W., Mehl, J. W., and Smyth, I., *J. Clin. Invest.*, **27**, 617 (1948).
[4] Mehl, J. W., Humphrey, J., and Winzler, R. J., *Proc. Soc. Exp. Biol.*, **72** 106 (1949). Mehl, J. W., Golden, F., and Winzler, R. J., *Proc. Soc. Exp. Biol.*, **72**, 110 (1949).
[5] Werner, I., and Odin L., *Upsala Läkarefören. Förhandl.*, N.F., **54**, Häft 1-2, 69 (1949).
[6] Brdicka, R., *Acta. Radiol. et Cancerol. Bohemiae et Moraviae*, **2**, 7 (1939).
[7] Morgan, W. T. S., and Elson, L. A., *Biochem. J.*, **28**, 988 (1934).
[8] Horowitz, N. H., Ikawa, M., and Fling, M., *Arch. Biochem.*, **25**, 1, 226 (1950).

A Sulphated Mucopolysaccharide in Human Dentine

THE presence of a polysaccharide resembling chondroitin sulphate in human dentine has already been described[1]. An undegraded polysaccharide with a low ash content has now been separated from human dentine. Dry human dentine (1 gm.) is reduced to a 180/200 mesh powder, then dialysed in 1 litre of 0·05 *N* hydrochloric acid for about ten days with frequent changes, at room temperature; this reduces the calcium content. When the outer fluid shows only a trace of calcium, *p*H of the suspension is brought to 6·0 and it is then heated to 80° for 20 min., as suggested by Partridge for cartilage[2]. The mass is then shaken with 10 per cent calcium chloride[3] and again dialysed against distilled water. The bulk is then made up to about two litres with distilled water, and *p*H adjusted again to 6·0. Separation of protein is effected by shaking with 80 ml. chloroform and 32 ml. amyl alcohol to each litre. The bulk is then reduced by boiling at about 42° under reduced pressure; drying is completed over phosphorus pentoxide. The yield from 1 gm. dry dentine was 26·4 mgm. polysaccharide.

The polysaccharide has been hydrolysed: (*a*) by a dried preparation of a Gram-negative bacillus isolated from dental caries; (*b*) by a living culture of *Penicillium spinulosum* at room temperature (kindly identified by Mr. G. Smith, of the London School of Hygiene); (*c*) by 2*N* hydrochloric acid in 10 hr. at 100°. Before hydrolysis neither free sulphate nor hexosamine can be detected, but both are found after hydrolysis by any of these three agents. Difficulty was met both in lowering the ash content and in separating polysaccharide from protein without degrading the polysaccharide. Meyer *et al.*[4] describe a method of preparation of chondroitin sulphate from cartilage in which shaking with a chloroform–amyl alcohol mixture is repeated twenty-four times. In the present work, despite prolonged and repeated shakings, all polysaccharide separated from dentine gave a trace of colour when tested by the Sakaguchi reaction.

	Chondroitin sulphate (theoretical, refs. 3, 4)		Found for sulphated mucopolysaccharide from human dentine	
C	30·7	per cent	42·0	per cent
H	4·8	,,	6·7	,,
N	2·6	,,	5·4	,,
S	5·9	,,	4·6	,,
Acetyl	8·1	,,	8·1	,,
OCH_3	0	,,	0	,,
Hexosamine	33·5	,,	26·3	,,
Hexuronic acid	36·5	,,	28·0	,,
Ash	0	,,	1·5	,,

I am indebted to the Medical Research Council for financial assistance, and to my colleagues at this Hospital.

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[1] Pincus, P., *Nature*, **162**, 1014 (1948).
[2] Partridge, S. M., *Biochem. J.*, **43**, 387 (1948).
[3] Meyer, K., and Smyth, E. M., *J. Biol. Chem.*, **119**, 507 (1937).
[4] Meyer, K. H., Odier, M. E., and Sigrist, A. E., *Helv. Chim. Acta*, **31**, 1400 (1948).

Inorganic Pyrophosphate in Insect Tissue

As reported earlier by Heller[1], the fat bodies of the male of the butterflies *Deilephila euphorbiæ* contain a substantial quantity, some 110 mgm. per cent, of phosphorus which yields inorganic orthophosphate on 7 minutes hydrolysis in *N* hydrochloric acid at 100° C. This readily hydrolysable phosphorus fraction, at first thought to consist chiefly of adenosinetriphosphate, was recently subjected by us to purification by the method of Jones[2] (as modified by Lehninger and Smith[3]), which consists in precipitation of inorganic pyrophosphate as manganese salt but leaves adenosinetriphosphate in solution.

In this way it was possible to show that only a part of the easily hydrolysable phosphorus present in the experimental material is adenosinetriphosphate, whereas as much as 60 per cent (in some preparations up to 80 per cent) of the 7-minutes hydrolysable phosphorus was identified as inorganic pyrophosphate. This was found to be localized mainly in the ductus ejaculatorius simplex (2,200 mgm. per cent phosphorus). It was converted into silver pyrophosphate which had a content of 71·4 per cent silver, as against 71·2 per cent required theoretically. The crude manganese precipitate was also found to contain a very small admixture of metaphosphate, and a small quantity of yet another metaphosphate compound was detected in the supernatant solution. The whole of the metaphosphate could be precipitated by the procedure used by Mann[4] for metaphosphate from moulds (precipitation with sodium hydroxide at *p*H 5·2 from a trichloroacetic–ethanol extract).

Hitherto the evidence for the occurrence of inorganic pyrophosphate in Nature was confined mainly to moulds[4] and yeast[5]. Our results, however, provide a proof of the occurrence of inorganic pyrophosphate in an animal tissue. They lend, at the same time, new significance to observations of other authors[6,7] concerning the role of inorganic pyrophosphate in the intermediary metabolism of cells.

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[1] Heller, J., *C.R. Soc. Biol., Paris*, **121**, 414 (1936).
[2] Jones, L. T., *Indust. and Eng. Chem., Anal. Ed.*, **14**, 536 (1942).
[3] Lehninger, A. L., and Smith, S. W., *J. Biol. Chem.*, **181**, 415 (1949).
[4] Mann, T., *Biochem. J.*, **38**, 339, 345 (1944).
[5] Umschweif, B., and Gibaylo, K., *Hoppe-Seyl. Z.*, **246**, 163; *Acta Biol. Exp., Varsovie*, **11**, 6 (1937).
[6] Cori, C. F., "Symposium on Respiratory Enzymes" (Wisconsin, 1942).
[7] Kornberg, A., *J. Biol. Chem.*, **176**, 1475 (1948).

A Simple Gasometric Method for the Analysis of the Fermentation-inhibiting Properties of Antimicrobic Agents

Recently, Heim and Poe in the United States introduced a very convenient method for evaluating antimicrobial properties of organic compounds[1]. They used, for example, *Aerobacter aerogenes* and *Saccharomyces cerevisiæ* as test strains, and based the estimation on the volume of gas found on incubation in lactose and glucose broth respectively for 72 hr. or less at 37° C. We have applied the same principle as a convenient method for estimating fermentation-inhibiting properties.

As an inoculum a 10 per cent suspension of fresh baker's yeast (*Saccharomyces cerevisiæ*) is used, in a concentration of 1 vol. per cent. This method of inoculation—which can be carried out in any laboratory, not necessarily specializing in microbiology—is prescribed by the Dutch Food Law in a test for establishing qualitatively the presence or absence of preservatives in fruit juices[2]. Counts on 'Difco' malt agar at 25° C. showed that such an inoculation corresponds to about 10^7 yeast organisms per ml. Variations due to different inoculations or to differences in the age of the baker's yeast used do not impair the consistency of the results obtained, since blanks are always carried out to eliminate these fluctuations.

Commercially bottled depectinized filtered apple juice ($n_D^{20} \sim 1{\cdot}350$, corresponding to about 12 per cent of sugars; *p*H about 3·5) was chosen as the medium. This juice is a satisfactory source of nutrients for yeasts[3] and possesses a fair buffer capacity. A further merit of this medium is that it is generally commercially available in Holland as a sterile liquid, free from preservatives; the latter are forbidden by the Food Law. Hence from this point of view, too, the method is generally applicable in purely chemical laboratories.

Incubation is carried out in sterilized ($\frac{1}{2}$ hr. at 170° C.) Einhorn tubes for 12–48 hr. at 25° C. The volume of gas formed is not recalculated to standard pressure. The inaccuracy involved by omitting this recalculation is about 1·2 per cent. This is significantly less than the precision of the technique, which in the 'best' replicates did not surpass 4·3 per cent.

The method has been used successfully in our laboratory for more than a year in testing preservatives and in detecting the same. It should be noted, however, that this method of detection and evaluation is only applicable to those preservatives which in the concentrations usually found in practice exert a powerful specific inhibition of yeast fermentation.

There exist some agents, for example, sulphonamides and antibiotics, which selectively inhibit the multiplication of micro-organisms. Such agents as a rule only become active after some divisions have occurred[4]. According to our measurements, this means that in the present test their action begins after a period of the order of 10 hr., that is, when fermentation as a rule is greatly advanced. Hence such agents do not greatly influence the results of the present fermentation test. To detect and evaluate compounds acting in the latter way a low inoculation (of the order of 10^4/ml.) must be used. The test then takes 48–96 hr. Work along these lines is in progress.

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[1] Heim, H. C., and Poe, C. F., *Food Tech.*, **2**, 23 (1948).
[2] Nederlandse Warenwet, Jam- Limonadebesluit, Staatsblad 1937, nr. 854; nadere wijziging dd 13 Augustus 1948, Staatsblad I. 369, Methoden van Onderzoek, Art. 20.
[3] Challinor, S. W., Kieser, M. E., and Pollard, A., *Nature*, **161**, 1023 (1948).
[4] Wolff, L. K., and Julius, H. W., *Annal. Inst. Pasteur*, **62**, 616 (1939).

Penetration of Benzpyrene through the Intact Skin of New-Born Mice

When the skin of the mouse is painted with a benzene or an acetone solution of a carcinogenic hydrocarbon, it is found afterwards that a part of the carcinogen remains in the keratinized layer of the epidermis, while some of the carcinogen (fluorescent material) immediately enters the pilo-sebaceous apparatus and is found dissolved in the lipid droplets within the gland cells. Several authors have suggested that the pilo-sebaceous apparatus plays an important part in the genesis of skin cancer by providing channels through which the carcinogen may penetrate the epidermis[1]. It was thought that a study of carcinogenic action on new-born mice[2,3,4] would throw light on this problem, for it has been observed that new-born mice (2–10 hr. after birth) are refractory to a single application of methylcholanthrene. The

absence of sebaceous glands, the lack of a way of entering via the hair follicles and also the thicker epidermis of new-born mice, confirmed by histological examination, would explain ineffectiveness of methylcholanthrene for tumour formation. The literature does not seem to contain any convincing evidence that the carcinogen is absorbed by the epidermal epidermis without mediation of the follicular pathways.

We have investigated, with the fluorescence microscope technique, the penetration of the carcinogen into the skin of new-born mice. In this investigation we have made use of some new solvents (mediators) for the carcinogenic hydrocarbons, characterized by their water- and fat-solubility ('Carbowaxes', certain polyethylene glycols, compounds in a non-aqueous state[5-7]), or their ability to dissolve both water- and fat-soluble substances (aqueous solutions of certain association colloids[8-12]).

Material and technique. The mice examined were of the mixed strain we have employed in our studies during recent years. The ages of the animals varied: 2, 5, 10, 15, 30 and 60 min., and from 1 to 24 hr. Adult mice were also examined, and the total number of animals used was about two hundred. A large area of the back of a mouse was painted and the animal killed 2–20 min. later, or after 24–48 hr. Skin sections, 10 microns in thickness—both with and without preceding fixation in a 10 per cent neutral formalin solution—were cut on a freezing microtome and examined immediately and again after twenty-four hours with a fluorescence microscope (Reichert Lux *UV* with a 'Philora'-lamp *HPW* 125 W.). The concentration of the carcinogen, 3 : 4-benzpyrene, in the various solutions was 0·5 per cent.

Observations. When the water- and fat-soluble 'Carbowax 1500' was used as mediator and solvent for benzpyrene, a blue to blue-violet fluorescence was encountered immediately after application, not only in the keratinized layers but also in all layers of the epidermis; both in the intercellular spaces and intracytoplasmic spaces in the cells (the nuclei, however, were devoid of fluorescent material), as well as in the subcutaneous fatty tissue. Although the new-born mice (2–60 min. after birth) had no open communications with the epidermal surface, benzpyrene (or its fluorescent metabolites) had entered the epidermis. Some of the mice, however, had a few sebaceous glands; but they were without any connexion with the skin surface. When the new-born mice were painted immediately after birth and killed twenty-four hours later, fluorescent material was observed to some extent in the keratinized part of the epidermis; but almost none was left in the epidermis itself, or in the subcutaneous fat, and none at all in the few newly developed sebaceous glands. In adult mice, that is, mice with a hair coat, the fluorescent material is, in general, observed in all the cutaneous elements mentioned twenty-four hours after a single application.

When the skin of new-born mice was painted with benzpyrene dissolved in other solvents, for example, acetone, fluorescent material was also found in the same elements of the skin.

The observations reported here indicate that benzpyrene can penetrate directly into the living epidermis by ways other than the pilo-sebaceous apparatus. On the other hand, however, it is quite clear that the carcinogens accumulate in the sebaceous glands and in the keratinized elements if they exist, and the route of maximum penetration is through the cutaneous openings. The epidermis will then, in the case of mice with developed hair coat, be continuously supplied with carcinogen from these 'stores'.

The present work is part of a systematic investigation on the significance of the nature of the solvent for the carcinogenic hydrocarbons in chemical carcinogenesis in general.

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[1] Simpson, W. L., and Cramer, W., *Cancer Res.*, **3**, 515 and 362 (1943); **5**, 5 (1945).
[2] Suntzeff, V., Carruthers, C., and Cowdry, E. V., *Cancer Res.*, **7**, 439 (1947); **8**, 390 (1948).
[3] Lacassagne, A., and Latarjet, R., *Cancer Res.*, **6**, 183 (1946).
[4] Cowdry, E. W., and Suntzeff, C., *Yale J. Biol. and Med.*, **17**, 47 (1944).
[5] Setälä, K., *Acta Path. Scand.*, **26**, 280 (1949).
[6] Setälä, K., *Ann. Med. exp. Fenniæ*, **26**, 126 (1948).
[7] Setälä, K., *Acta Path. Scand.*, **26**, 223 (1949).
[8] Ekwall, P., VI Nordiska Kemistmötet, 179 (Lund, 1947).
[9] Ekwall, P., and Setälä, K., *Acta Chem. Scand.*, **2**, 733 (1948).
[10] Ekwall, P., and Setälä, K., *Acta Path. Scand.*, **26**, 795 (1949).
[11] Setälä, K., and Ekwall, P., *Acta Path. Scand.*, **26**, 804 (1949).
[12] Setälä, K., and Ekwall, P., *Ann. Med. Exp. Fenniæ* (in the press).

Oriented Overgrowth of Alkali Halides on Metals

IN a recent discussion of oriented overgrowth, Sir George Thomson[1] has pointed out that near equality of spacing of atoms in the two crystals in contact is not always a necessary condition for such growth to occur. It appeared that the presence of cracks or steps in the mother crystal plays an important part. Some evidence for this belief was the observation of Andrade and Martindale[2] that small crystals of gold or silver grown on glass and diamonds show a preference for nucleation on cracks or scratches on the surface.

Although many examples of oriented overgrowth are known, there are very few cases of growth of ionic crystals from solution on metallic surfaces. Royer[3] concluded that such growth is unlikely between substances of different binding. Sloat and Menzies[4] observed oriented growth of ammonium bromide and caesium chloride on a silver crystal the lattice constants of which differed from that of silver by less than 1 per cent. These observations led to the view that oriented overgrowth of ionic crystals from solution on metals would occur only in special circumstances and only when the lattice fit was particularly close.

I have made several new observations of epitaxy of alkali halides crystallized from solution on metallic surfaces which clearly show that this view must be modified. The salts were crystallized from an ethyl alcohol – water solution. The effects were observed under an optical microscope. Strong orienting effects have been found in the following cases:

(1) Sodium chloride on the (100) and (111) planes of silver (oriented thin films), on the (111) plane of copper, and on polycrystalline antimony, bismuth, zinc and silver.

(2) On the (111) plane of a cleaved crystal of bismuth, sodium, potassium and rubidium chlorides were all oriented, and the orientation appeared to be the

Fig. 1 Fig. 2 Fig. 3

Fig. 1. Oriented overgrowth of sodium chloride on polycrystalline silver after polishing and etching. Note the variation of density of crystallization from one grain to another. × 75

Fig. 2. Structure of silver sheet revealed by preferential crystallization of sodium chloride on polished polycrystalline silver (unetched). × 75

Fig. 3. Oriented overgrowth of sodium chloride on polycrystalline zinc. Note preference of grain boundaries in some cases as sites for crystallization. × 37

same in all cases. On cleaved antimony, only sodium chloride was oriented. The cleaved surface of bismuth or antimony is covered with steps which give the appearance of straight lines intersecting at about 60°.

The alkali chloride crystals assumed the form of equilateral triangles or hexagons, and in every case the straight edges were parallel to the cleavage lines of the bismuth or antimony surface. This lends support to Thomson's view of the mechanism of orientation, since important lines of atoms in the crystals did coincide with the directions of the steps in the surface. However, the fact that only sodium chloride was oriented by antimony indicates that lattice spacings also must be considered. Polishing the cleavage planes and etching in perchloric acid gave surfaces which oriented the halide crystals in the same manner as had the original surface.

(3) With polycrystalline iron–silicon (3 per cent silicon), on only one grain out of about forty examined was epitaxy observed, in this case only with caesium chloride. X-ray diffraction revealed this grain to be oriented with its (100) plane parallel to the surface. Attempts to observe epitaxy on a (110) face of such a crystal all failed.

On most other polycrystalline materials some form of epitaxy occurred on almost every grain. A typical example is given in Fig. 1, which shows this effect with sodium chloride on polycrystalline silver. The distribution of crystallization was uniform over each grain, or if it was twinned, over those parts of the grain with the same orientation. The density of crystallization varied from grain to grain depending upon their orientations. The latter result was used in one instance to reveal the grain structure of polycrystalline silver (Fig. 2). The grain structure was brought out by producing very small ($\sim 1\,\mu$ diameter) crystals of sodium chloride using a strongly alcoholic solution and rapid drying.

In general, no preference for grain boundaries as sites for nucleation of crystallization was observed; however, with sodium chloride on zinc such a preference was indicated (Fig. 3). From the results of Andrade and Martindale it might have been expected that the grain boundaries on an etched surface would be likely sites for nucleation.

It is clear that closeness of fit cannot be regarded as a strict criterion for the occurrence of epitaxy for the systems described here; for, first of all, on cleaved bismuth, salts with lattice constants differing by 15 per cent (sodium and rubidium chlorides) were oriented in the same way. In addition, since some form of epitaxy was noted for almost all grain orientations on polycrystalline metals (except iron), it appears unlikely that close fits could be achieved for all of them. Finally, sodium chloride was oriented in the same way on the (111) planes of both silver and copper, the lattice constants of which differ by about 10 per cent.

That the orientation of the alkali halide crystals was determined in the embryonic stages of growth is suggested by the observation that the crystals often grew across grain boundaries and over surfaces of different orientation without modification.

This work was carried out at the Brookhaven National Laboratory under the auspices of the Atomic Energy Commission.

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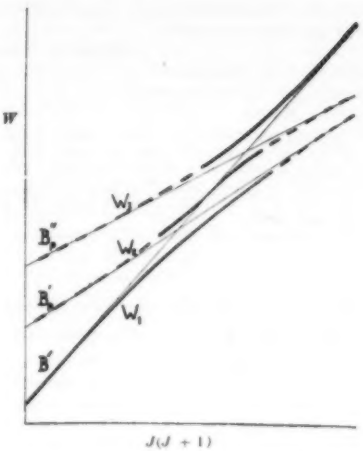
[1] Thomson, G. P., *Proc. Phys. Soc.*, **61**, 403 (1948).
[2] Andrade, E. N., and Martindale, J. C., *Phil. Trans. Roy. Soc.*, **235**, 69 (1936).
[3] Royer, L., *Bull. Soc. Franc. Miner.*, **51**, 7 (1928).
[4] Sloat, C. A., and Menzies, A. W. C., *J. Phys. Chem.*, **35**, 2005 (1931).

An Infra-Red Band-System of Calcium Oxide

The introduction of calcium salts into flames or arcs gives, in the presence of oxygen, a very complicated band-spectrum from the near ultra-violet up to the infra-red. The spectrum contains several systems, most of which can be attributed to CaO. The analyses hitherto performed—both vibrational and rotational—do not, however, appear entirely trustworthy. Brodersen[1,2] has given, in two papers, rotational analyses of some infra-red and blue bands. He has also tried unconvincingly to arrange several band-systems into an energy-level scheme. This scheme seems to us to be very artificial.

We therefore considered it desirable to carry out new rotational analyses, in the first place of the infra-red bands. As source we used an arc between pure calcium electrodes burning in air. In the region 7000–9000 A. the spectrograms were taken in the



first order of a 21-ft. Wood concave grating having a dispersion of about 1·1 A./mm. Between 9000 and 10,500 A., a plane grating with dispersion 4·5 A./mm. in the second order was used.

In the low-dispersion plates, five clear sequences appear at 7308, 7715, 8153, 8652 and 9229 A. These bands comprise a $^1\Sigma - {}^1\Sigma$ band-system with the 0,0 band at 8652 A. Sixteen bands have been analysed, namely, the 6,3, 5,2, 5,3, 4,1, 4,2, 3,0, 3,1, 3,2, 2,0, 2,1, 2,3, 1,0, 1,1, 1,2, 0,0 and 0,1 bands. The rotational constants derived in the present work are as follows :

$B'_0 = 0{\cdot}396_0$
$B'_1 = 0{\cdot}398_0$
$B'_2 = 0{\cdot}400_2$
$B'_3 = 0{\cdot}401_6$
$B'_4 = 0{\cdot}402_3$
$B'_5 = 0{\cdot}403_6$
$B'_6 = 0{\cdot}405_1$
$r_e = 1{\cdot}906 \times 10^{-8}$ cm.
$D' = 0{\cdot}55 \times 10^{-6}$
$\omega'_e \sim 715$

$B''_0 = 0{\cdot}4328$
$B''_1 = 0{\cdot}4362$
$B''_{1'} = 0{\cdot}4394$
$B''_2 = 0{\cdot}4428_0$
$r''_e = 1{\cdot}822 \times 10^{-8}$
$D'' = 0{\cdot}66 \times 10^{-6}$
$\omega''_e = 732{\cdot}1_1$
$r_e''\omega_e = 4{\cdot}8_1$

In the upper vibrational levels the bands are strongly perturbed. The perturbations displace the positions of the bands in the sequences and make the analysis very complicated in some parts. In the 0,0 band a very curious perturbation appears. For some J-values the upper level $v' = 0$ is perturbed by two states. The accompanying graph shows the energy-levels $BJ(J+1)$ plotted against $J(J+1)$ of the three interacting terms. The energy curves are marked W_1, W_2 and W_3. In the perturbed region, three R- and three P-lines are found. As we know that the centre of gravity energy line is unperturbed, we obtain by calculation the following equation for the relation between the B-values :

$$\frac{B' + B'_p + B''_p}{3} - B'' = \frac{1}{12J} \sum_1^3 \left[P_\nu(J+1) - R_\nu(J-1) - P_\nu(J) + R_\nu(J-2) \right],$$

where the suffixes 1, 2 and 3 indicate lines from the three interacting energy-levels W_1, W_2 and W_3. For $J = 54$, 55, 56 and 57, the value of $(B_p + B''_p)$ is found to be 0·7102, 0·7099, 0·7100 and 0·7103 respectively.

The B'_v-values vary rather irregularly. This is due to the strong perturbations. We would stress that for strongly perturbed levels it is almost meaningless to speak of a fixed B-value, as it varies from one rotational level to the next. In most cases the B-value given is that nearest to the 'unperturbed' one.

A lot of bands are situated between 9500 and 10,500 A. They form other band-systems belonging to CaO. Meggers[3] has given some measurements of the band-heads.

A more detailed paper will appear in *Arkiv för Fysik*.

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[1] Brodersen, P. H., *Z. Phys.*, **79**, 613 (1932).
[2] Brodersen, P. H., *Z. Phys.*, **104**, 135 (1936).
[3] Meggers, W. F., *U.S. Bur. Stand. J. Res.*, **10**, 669 (1933).

Electric Strength of Aluminium Oxide Films

FRÖHLICH'S theory of dielectrics predicts an increase in the electric strength as the thickness of the dielectric specimen approaches the electronic mean free path. This prediction has been verified experimentally for certain crystalline materials, such as mica and the alkali halides. Recent work with thin films of amorphous aluminium oxide shows that its electric strength also increases if the film thickness is less than 10^{-5} cm. The oxide was formed by 'anodic oxidation' of aluminium which had been evaporated in a vacuum on a glass optical flat, the film thickness being measured by means of multiple reflexion fringes. The potential difference across the film was applied through small steel bearings. Some of the results obtained at 290° K. in a vacuum of 10^{-5} mm. of mercury are as follow :

Film thickness (A.)	134	195	580	830	1540
Electric strength (volts/cm. × 10^6)	11·0	9·9	7·3	6·3	5·2

A full account of the investigations is being published elsewhere.

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Oscillator Strength of the Na_2 $^1\Sigma$—$^1\Sigma$ Transition

WHILE the oscillator strengths (or f-values) of various molecular electronic transitions are urgently required by astrophysicists, very few experimental or theoretical results are available. I have recently carried out a calculation for the f-value of the $^1\Sigma - {}^1\Sigma$ transition of the sodium molecule based on the simple hydrogen-ion model. In this calculation the wave functions of the two states were represented by a simple linear combination of the appropriate atomic wave functions (these being taken as Slater-type functions with effective nuclear charge $2{\cdot}2e$ and $n^* = 3$). Taking the internuclear distance as $3{\cdot}36\,a_0$ (a_0 is the radius of first Bohr orbit) and the wave-length of the electronic transition as 6812 A., the f-value was found to be 0·26, corresponding to a mean life-time of $1{\cdot}7 \times 10^{-8}$ sec. No experimental measurement of this life-time has yet been made, but the value would not be expected to be widely

different from the value for the blue-green system ($^1\Sigma - {}^1\Pi$), which has approximately the same intensity. The life-time of this system was measured by Hupfeld[1] and found to be $1{\cdot}0 \times 10^{-6}$ sec., which is of the same order as the theoretical result. Further results based on the hydrogen-ion and the hydrogen-molecule approximations will be reported in greater detail at a later date.

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Relative Diameters of Galaxies

IN their communication on galactic noise and the rotation of the galaxy[1], Bolton and Westfold remark, on the basis of some early measures from the Mt. Wilson Observatory[2], that "the size of the external galaxies increases steadily with increasing spiral structure", and this result is used to support the surmise that our own large galaxy presumably has spiral structure. There are other strong evidences of the spiral structure of our galactic system, and therefore the revision of the results underlying the statement quoted above is of no consequence to the subject-matter of the communication by Bolton and Westfold.

The general inspection, and later the visual measurement of the ordinary photographs of external galaxies, indicated to both the Harvard and Mt. Wilson observers many years ago that the spheroidal and elliptical systems were distinctly smaller than the spirals. The later Harvard work with appropriately exposed small-scale plates showed, however, that there is no essential difference in the over-all size of spheroidal and spiral galaxies[3]. Afterwards, the microdensitometer was used to measure the photographic images, the equality of dimensions was confirmed, and both the spheroidal and the spiral systems were found to be much larger than previously supposed[4]. For example, the Mt. Wilson estimates gave the mean linear diameter of the spheroidal systems *E*0, *E*1, . . . *E*7 as 0·36, 0·43, . . . 1·13 kiloparsecs, whereas comparable Harvard measures on small-scale plates gave the mean values of *E*0–*E*7 as 3·7 kps.

When the Harvard plates of the Virgo Cloud of galaxies were measured with the microdensitometer, the following results were obtained, with the diameters in kiloparsecs.

Class	Median	Mean	Number
*E*0–*E*7	4·6	4·9 ± 0·4	13
*S*0, *Sa*, *Sb*	4·2	4·4 ± 0·2	30
Sc	4·3	4·7 ± 0·3	69

Another determination with allowance for the possible selection on the basis of apparent magnitude gave 4·05 and 4·57 kiloparsecs for the mean diameters for spheroidal and spirals, respectively.

The spiral structure ordinarily photographed in external galaxies is rarely detected at more than half a radius from the nucleus. The arms are, in a sense, superficial, involving in most instances less than a quarter of the mass and light of the galaxy, and in my view they indicate an early stage in the development of a galactic system[4,5].

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[1] Bolton, J. G., and Westfold, K. C., *Nature*, **165**, 487 (1950).
[2] Hubble, E. P., *Mt. Wilson Contr.*, **324**, 42 (1926). See also "The Realm of the Nebulæ", 178 (Yale Univ. Press, 1936).
[3] Shapley, H., *Mon. Not. Roy. Astro. Soc.*, **94**, 807 (1934).
[4] Shapley, H., *Proc. U.S. Nat. Acad. Sci.*, **28**, 186 (1942), and *Harv. Rep.*, No. 238 (1942).
[5] Shapley, H., "Galaxies", 170, 171, 214–219 (Blakiston, 1943).

New General Methods for the Synthesis of Fluoroiodides and Fluoroacids

THE unusual properties associated with the fluorocarbons are now well defined, and current interest lies in the synthesis of compounds which contain fluorocarbon groups such as perfluoroalkyl groups. For such syntheses, compounds of the type *RX* are required, where *R* is a fluoroalkyl group (CF_3, CF_2Cl, C_2F_5, etc.) and *X* is a reactive group. The fluoroacids ($X = COOH$) are examples of such compounds, but lead in general to compounds of the general formula RCH_2Y, in which a $—CH_2—$ group has been introduced. The fluoroiodides, *RI*, have received attention recently, and it is now known that they readily yield perfluoroalkyl radicals which can be used for synthetic work. In particular, it has been reported that trifluoroiodomethane will bring about an addition polymerization with ethylene[1] and with acetylene[2] to give compounds of the type $CF_3[CH_2CH_2]_nI$ and $CF_3[CH{=}CH]_nI$.

The method used for the synthesis of trifluoroiodomethane until recently was the fluorination of carbon tetraiodide with iodine pentafluoride[3]. A method has now been evolved for the synthesis of this fluoroiodide in good yield from the commercially available trifluoroacetic acid. When salts of this acid—lead, silver and even sodium or potassium—are thoroughly mixed with iodine and heated, simultaneous decarboxylation and iodination occur, and the gaseous products are carbon dioxide and trifluoroiodomethane. The fluoroiodide, easily purified by fractionation, can thus be prepared without recourse to elementary fluorine. This reaction is general for the synthesis of fluoroiodides. Dicarboxylic fluoroacids yield diiodides, and fluoroiodides such as CF_2ClI, $CFCl_2I$, CHF_2I, CF_2I_2 and $I(CF_2)_{2-4}I$ are now easily prepared. Fluoroiodides derived from other fluorohaloacids are being investigated. By treatment with iodine pentafluoride as described previously[4], the compounds $I(CF_2)_{2-4}I$ can be converted into $CF_3(CF_2)_{1-3}I$.

Now, it has been shown that a fluoroiodide such as trifluoroiodomethane will undergo an addition-polymerization with tetrafluoroethylene to give a polymer $CF_3[CF_2CF_2]_nI$, from which the compounds with $n = 1$–10 may be isolated[1]. From the fluoroiodides, *RI*, mentioned above, it will be possible to synthesize the compounds $R[CF_2CF_2]_nI$, where $n =$ 1–10. The fluoroiodides can be converted into the corresponding carboxylic acids by the general procedure of reaction with acetylene and isolation of the first member of the series (which constitutes *c.* 80 per cent of the product), followed by permanganate oxidation; the double bond on a carbon atom adjacent to a fluoro group is susceptible to oxidation, and $CF_3CH{=}CHI$, for example, readily yields trifluoroacetic acid.

The synthesis of the new perfluoro acid pentafluoropropionic acid, achieved in collaboration with Mr. K. Leedham, also illustrates this reaction. Pentafluoroiodoethane (prepared from tetrafluoroethylene[4]) and acetylene yield 1 : 1 : 1 : 2 : 2 pentafluoro 4-iodobutene (b.p. 84·4°), which with alkaline permanganate affords pentafluoropropionic acid (b.p. *c.* 95°), characterized as its amide (m.p. 95–95·5°). Like trifluoroacetic acid, pentafluoropropionic acid is a strong acid which fumes in air and which has a high density and low refractive index. Similarly, heptafluorobutyric acid, described recently[5], has been synthesized from heptafluoroiodopropane.

Thus, two general synthetic methods are now available; the first, to prepare fluoroiodides from the corresponding fluoroacids; the second, to convert fluoroiodides, prepared by various routes, into the corresponding fluoroacids. The properties of some of the compounds mentioned above are being studied and will be described in more detail elsewhere.

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[1] Haszeldine, *J. Chem. Soc.*, 2856 (1949).
[2] Haszeldine, *Nature*, **165**, 152 (1950).
[3] Banks, Emeléus, Haszeldine and Kerrigan, *J. Chem. Soc.*, 2188 (1948).
[4] Emeléus and Haszeldine, *J. Chem. Soc.*, 2948 (1949).
[5] Husted and Ahlbrecht, Abstracts, American Chemical Society, 116th Meeting, September 1949, 10K.

Electron Affinities of Some Aromatic Molecules

Evidence[1] is available to indicate that in the reduction of some aromatic molecules at the dropping mercury electrode one electron is added on to the neutral molecule.

From a knowledge of the absolute potential, E, at which this reduction occurs, of the photo-electric work function, χ, of mercury and of the solvation energy, S, of the ion formed, it is possible to calculate simply the electron affinity, A, of the neutral molecule.

To do this, consider the process of reduction as taking place in three stages:

$$(Hg)_{drop} \rightarrow (Hg)^{+}_{drop} + e \qquad (1)$$

$$R + e \rightarrow R^{-} \qquad (2)$$

$$R^{-} + aq. \rightarrow R^{-}(aq.) \qquad (3)$$

where R is the neutral molecule.

The energy used is χ for 1, $-A$ for 2 and $-S$ for 3, a total of $\chi - A - S$. This is put equal to E, which can be determined experimentally. S may be calculated from the modified Born equation[2] for a singly charged anion in water, and $\chi = 4{\cdot}52$ eV. The radius of the ion needed in the Born equation can be calculated from the molar volume. For triphenyl methyl, $S = 1{\cdot}46$ eV.; hence, $A = +2{\cdot}62$ ($\pm 0{\cdot}05$) eV.

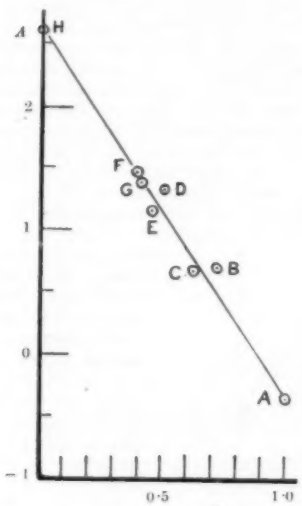
Triphenyl methyl is the only one of the compounds considered for which previously determined values of A have been found. In these cases, by methods completely different from the present, A was $2{\cdot}56 \pm 0{\cdot}2$ eV.[3], and $2{\cdot}09 \pm 0{\cdot}2$ eV.[4].

Results for other molecules are quoted in the accompanying table. The order of electron affinity

Molecule	E^{a} (eV.)	S (eV.)	A (eV.)	Addition of sodium[5]
Benzene	2·87	2·01	−0·36	nil
Diphenyl	2·15	1·67	+0·70	nil
Naphthalene	1·99	1·86	+0·67	slowly
Stilbene	1·61	1·58	+1·33	
Pyrene	1·57	1·79	+1·16	
1 : 4 Diphenyl butadiene	1·46	1·59	+1·47	rather easily
Anthracene	1·42	1·72	+1·38	easily
Triphenyl methyl	0·44	1·46	+2·62	very easily

increase is similar to the order of readiness of addition of alkali metals[6]. Thus the values of A have considerable qualitative and some quantitative support.

A seeming objection to the inclusion of S as a potential-determining factor is that the reduction (half-wave) potential was found[1] to give a linear plot against the coefficient, a, of the molecular orbital resonance integral, which is, of course, independent of solvation effects. But a plot of $E + S$ against a is also linear (with deviations attributed to theoretical approximations in the admittedly first-order calculation of a). Thus A depends linearly on a (see graph), and Maccoll's general conclusion[1] is unimpaired, although he made no allowance for solvation effects.



A, benzene; *B*, diphenyl; *C*, naphthalene; *D*, stilbene; *E*, pyrene; *F*, 1 : 4 diphenyl butadiene; *G*, anthracene; *H*, triphenyl methyl

Benzene is interesting because, of the molecules listed, it alone has a negative electron affinity. Benzene has not been reduced polarographically. Conditions to enable this to be done are now being sought in my laboratory. The point shown on the graph is estimated from the known a by Maccoll's original curve, corrected by the appropriate S.

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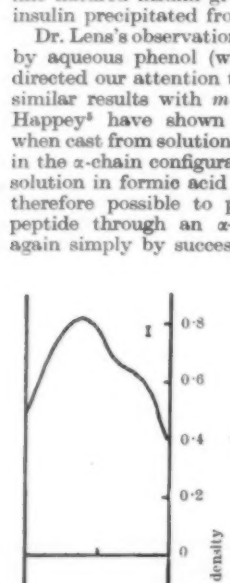
[1] Maccoll, *Nature*, **163**, 178 (1949).
[2] Hush, *Aust. J. Sci. Res.*, A, **1**, 480 (1948).
[3] Bent, *J. Amer. Chem. Soc.*, **52**, 1499 (1930).
[4] Swift, *J. Amer. Chem. Soc.*, **60**, 1403 (1938).
[5] Hückel. Proc. Int. Conf. Physics 1934, **2**, 1.
[6] Wawzownek *et al.*, *J. Amer. Chem. Soc.*, **64**, 1765, 2365 (1942); **68**, 2541 (1946).

Chain Configurations in Natured and Denatured Insulin: Evidence from Infra-red Spectra

THE range of techniques available for studying the denaturing and renaturing of proteins has recently been increased by the observation[1] that a change from the extended (β) chain configuration of a synthetic polypeptide to the folded (α) form is accompanied by an increase in the frequency of the infra-red absorption band characteristic of the C = O peptide link. There is already evidence[2] that some denaturing processes in proteins are accompanied by an unfolding of polypeptide chains, producing the extended β-form, and it seemed of interest to see if evidence on this point could be obtained from infra-red spectra.

Insulin can be denatured and renatured (in the sense that the biological activity can be removed and later restored) by simple processes. The subject has been reviewed by Sanger[3]. We have measured the C=O absorption band of these two forms of insulin; these are shown in the accompanying figure, whence it may be seen that the frequency does indeed diminish as a result of denaturation. Crystalline natured insulin gives a curve similar to that of insulin precipitated from aqueous phenol.

Dr. Lens's observation[4] that insulin can be renatured by aqueous phenol (which he has described to us) directed our attention to the possibility of producing similar results with *m*-cresol. Bamford, Hanby and Happey[5] have shown that synthetic polypeptides when cast from solution in *m*-cresol are predominantly in the α-chain configuration, whereas when cast from solution in formic acid they are in the β-form. It is therefore possible to pass a given synthetic polypeptide through an α–β transformation and back again simply by successive solution and reprecipitations from these two solvents. In addition, it is possible to follow the various stages by means of the C=O frequency-shift described above.



I. Insulin denatured by boiling in dilute HCl solution. II. Insulin precipitated from aqueous phenol (natured)

A sample of crystalline insulin was passed through the same cycle. It showed exactly the same kind of frequency shifts of the C=O band as had been observed in synthetic polypeptides. The film cast from formic acid at a high temperature gave a curve similar to that of the denatured protein (I in figure). It was confirmed by chemical analysis that there was no formic acid in the specimen. This material was redissolved in *m*-cresol and recast as a film. A curve similar to the natured form (II in figure) was obtained.

These results are consistent with the view (though not perhaps excluding other explanations) that natured insulin consists of polypeptide chains in the same α-fold as α-synthetic polypeptides, and that denaturation is accompanied by an extension of the chains into the β-configuration. The type of α-fold, which has been suggested in earlier papers[6,7,1], enables the α–β transformation to occur without any marked change in the packing of side-chains but merely by rotation of the

groups about bonds attached to the asymmetric carbon atom. No rotation of side-chains about the chain axis is required. With this kind of fold in natured insulin, the α–β transformation could occur without breaking the disulphide linkages between chains. It is known that these disulphide linkages must be preserved[3] if the denaturation is to be reversible.

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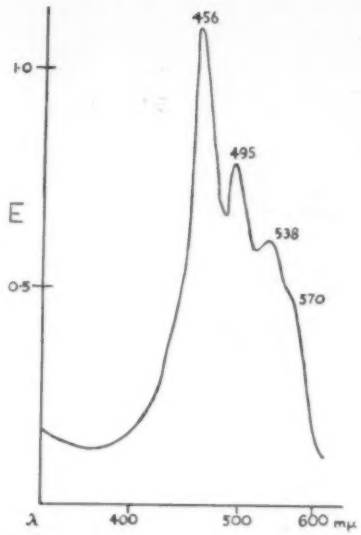
[1] Elliott, A., and Ambrose, E. J., *Nature* [**165**, 921 (1950)]. A full account of this work has been communicated to the Royal Society.
[2] Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **29**, 2351 (1935).
[3] Sanger, F., Ann. Rep. Chem. Soc., **45**, 285 (1948).
[4] Lens, J., *J. Biol. Chem.*, **169**, 313 (1947).
[5] Bamford, C. H., Hanby, W. E., and Happey, F., *Nature*, **164**, 138 (1949).
[6] Ambrose, E. J., and Hanby, W. E., *Nature*, **163**, 483 (1949).
[7] Ambrose, E. J., Elliott, A., and Temple, R. B., *Nature*, **163**, 859 (1949).

A Subsidiary Shell Pigment of *Haliotis cracherodii* Leach

IN previous communications[1], I have described investigations of the chief blue pigment extracted by acids from the shell of the gastropod *Haliotis cracherodii* Leach. Important evidence has been produced by Tixier and Lederer[2] against our view, based largely on spectroscopic findings, that this pigment is an indigoid. A joint study of the blue pigment, in collaboration with these workers, is in progress. In the meantime, we have obtained one of the accompanying yellow pigments in sufficient yield to perform spectrographic studies upon it, and upon its zinc complex.

The yellow material forms one of the discrete fractions obtained by chromatography in chloroform upon talc of the mixture formed when shell extracts in 3*N* hydrochloric acid are shaken with amyl alcohol and the epiphase evaporated to dryness. It is soluble in ether and in chloroform, is precipitated as an amorphous powder by adding petroleum ether to the chloroform solution, and shows no visual absorption bands in neutral solvents. Spectrophotometry shows well-defined maxima at about 4400 and 4900 A.

Upon addition of methanolic zinc acetate, a crimson zinc complex, reversibly decomposed by acids, is formed. This material has a strong four-banded spectrum and gives an orange fluorescence in ultraviolet light. It, too, is precipitated by petroleum ether from chloroform, but attempts to crystallize it have so far failed. The plot obtained with the Holiday continuous-recording spectrophotometer is shown in the accompanying graph. The sample examined was homogeneous, both in the free state and as the zinc complex, upon repeated chromatography.



The absorption spectrum is not consonant with any of the commoner natural pyrroles. The behaviour of the zinc complex, however, is more suggestive of a pyrrolic material than of any other type of pigment, and in no way resembles an indigoid. Its occurrence in association with the blue pigment is therefore presumptive evidence in favour of the view expressed by Tixier and Lederer.

Acknowledgment is due to Dr. E. R. Holiday, of the Medical Research Council Spectrographic Unit, for the spectrophotometric studies.

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[1] Comfort, A., *Nature*, **162**, 851 (1948): *Biochem. J.*, **45**, 204 (1949).
[2] Tixier, R., and Lederer, E., *C.R. Acad. Sci., Paris*, **228**, 1669 (1949).

Chromatographic Analysis of Eucalypt Kinos

KINOS are dark cellular accretions or astringent exudations containing phenolic substances. They are commonly seen as vitreous lumps on the bark, or as veins in the timber, of many eucalypts, and are locally known as 'gums'. The kinos of certain eucalypts have been examined by the Williams and Kirby's solvent ascent modification[1] of the paper partition chromatographic technique[2].

Butanol – acetic acid – water (40–10–50 per cent by volume) has been used successfully to resolve quebracho tannin[3], flavanoid pigments[4], etc., and also by me for the examination of the extracts of the timber of *Acacia decurrens*, Willd., *Sloanea woollsii* F. v. M., *Litsea reticulata* Benth. and *Alstonia scholaris* R.Br. This solvent gave poor resolution of the components of the eucalypt kinos, and phenol–water solvent, although more suitable, did not sharply resolve them.

Many new solvent mixtures were tried and their efficiency gauged by observing the relative positions and intensities of fluorescence of the components when the paper sheets were viewed under ultra-violet light. The most suitable solvents were found to be: (*a*) a mixture of equal volumes of phenol and 2*N* acetic acid to which 0·3 per cent sodium chloride was added; (*b*) a mixture of equal volumes of phenol and an aqueous solution 2*N* with respect to both acetic and hydrochloric acids; (*c*) ethanol–benzene–water (40–20–40 per cent by volume).

Solvents (*a*) and (*b*) gave comparable R_F values; but solvent (*b*) was more suitable for samples of kino which had been collected for some time, when some components were not so strongly fluorescent in the absence of hydrochloric acid. Solvent (*c*) resolved only those components which had a high R_F value in the phenol solvents.

The phenol was purified by a hitherto unreported method; it was agitated for a few minutes with 4 per cent of its weight of concentrated sulphuric acid – potassium dichromate mixture (90–10 per cent by weight), heated under reflux at about 150° C. for one hour, then poured off and distilled under vacuum using an efficient splash-head. After this treatment the phenol remained completely colourless for several months.

Relatively large amounts of kino (6–15 mgm.) were necessary to enable later detection of the components. The kino of *E. calophylla* R.Br. (marri) was resolved into at least twelve components (six fluorescent and six detected by Tollen's reagent), that of *E. corymbosa* Sm. into at least thirteen components (five fluorescent, seven by Tollen's reagent, one by both), that of *E. goniocalyx* F.v.M. into at least eleven components (four fluorescent, five by Tollen's reagent, one by both, and one carbohydrate by Partridge's reagent[5]).

Aromadrendrin[6] had an R_F value of 0·79 and a green fluorescence in ultra-violet light.

This work will be published more fully elsewhere.

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[1] Williams, R. J., and Kirby, H., *Science*, **107**, 481 (1948).
[2] Consden, R., Gordon, A. H., and Martin, A. J. P., *Biochem. J.*, **38**, 224 (1944).
[3] White, T., *J. Soc. Leather Trades' Chem.*, **33**, 39 (1949).
[4] Wender, S. H., and Gage, T. B., *Science*, **109**, 287 (1949).
[5] Partridge, S. M., *Nature*, **164**, 443 (1949).
[6] Smith, H. G., *Proc. Roy. Soc. N.S.W.*, **30**, 135 (1896).

Chemical Delignification of Flax Straw and Other Cellulosic Materials

THE retting of flax, which is a delignification and a degumming process brought about by micro-organisms, has been used in Europe for many years in the linen industry. Retting is usually applied to the straw of a variety of flax which has been developed and grown to give long stems. Moreover, the straw is harvested before lignification has proceeded too far.

In the United States of America, a large amount of flax is grown for its seed and not for its fibre, and consequently the straw forms a relatively large agricultural waste product. Investigations have been proceeding for several years in this University into the possible utilization of seed-flax straw. One object of these studies was to devise a chemical method of delignification or retting which could be applied to seed-flax straw in which lignification has proceeded to completion, so that waste straw could be used for

making linen. Chemical methods of delignification do not usually give a suitable product for making linen yarn because the cellulose fibres are either weakened or shortened[1] to such an extent that spinning cannot be accomplished. The delignification procedures used in the paper industry, for example, are much too drastic to produce the effect of natural retting, inasmuch as they usually result in partial or complete pulping of the bast fibres[2]. The method for the preparation of holo-cellulose which involves the use of chlorine dioxide[3-6] has, however, been applied with some success to the delignification of flax roving which has been freed from as much of the woody shives as possible[7]. More recently, we have found that one treatment of seed-flax straw or roving for two hours at 155° C. under pressure with an aqueous solution containing sodium hydrosulphite ($Na_2S_2O_4$) frequently called 'hydros' (2 per cent) and sodium hydroxide (2 per cent) results in complete extraction of the lignin. Furthermore, the residual cellulose fibres can readily be spun into yarn.

Apart from its possible industrial application in the linen industry and its potential use for the determination of 'holo-cellulose' and lignin, the alkaline hydrosulphite reagent enables the constituents of cellulosic materials to be separated and hence investigated. Thus, flax straw has afforded cellulose, lignin, hemicellulose or flax gum and a pectic acid[8]. The cellulose remains undissolved by the reagent. The lignin may be precipitated by acidification of the alkaline extract as a light-coloured amorphous powder. The flax pectic acid can be separated as a salt, and the flax gum or hemicelliulose is recoverable from the mother liquors.

This alkaline hydrosulphite method can be used for the delignification of grains, leaves and straws, and preliminary experiments with various kinds of wood indicate that the reagent is capable of extracting lignin from these cellulose-containing products. Further details of this work will appear elsewhere.

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[1] Taylor, J. E., *Georgia State Eng. Exp. Station Bull.*, No. 10, **3**, No. 6 (1946).
[2] Wise, L. E. E., "Wood Chemistry", 696 (New York: Reinhold Publishing Corp., 1944).
[3] Taylor, M. C., White, J. F., Vincent, G. P., and Cunningham, G. L., *Indust. Eng. Chem.*, **32**, 899 (1940).
[4] Vincent, G. P., *Pulp Paper Mag. Can.*, **41**, 781 (1940).
[5] White, J. F., and Vincent, G. P., *Paper Trade J.*, **111**, No. 12, 39 (1940).
[6] Wise, L. E., Murphy, M., and D'Addieco, A. A., *Paper Trade J.*, **122**, No. 2, 35 (1946).
[7] Amdur, E., Montonna, R. E., and Reyerson, L., U.S. Pat. 2,468,771.
[8] Cf. Ehrlich, F., and Schubert, F., *Biochem. Z.*, **169**, 13 (1926).

Induced Vitamin-requiring Mutants of *Chlamydomonas*

A few instances of vitamin requirements among green algæ have been recorded. Since the isolation of algæ has usually involved an enrichment in a mineral solution, which would select against species with organic growth-substance requirements, our present knowledge of algal physiology is strongly biased in favour of completely autotrophic forms.

Chlamydomonas chlamydogama Bold has been recently shown to require, *inter alia*, vitamin B_{12} [1], while several other species of *Chlamydomonas* have been reported to require aneurin for rapid growth under heterotrophic conditions[2]. The aneurin requirements of some colourless counterparts of *Chlamydomonas* (*Polytoma* spp., etc.) have been extensively investigated by Lwoff and Dusi[3].

Following ultra-violet irradiation of the completely autotrophic *Chlamydomonas Moewusii* Gerloff, two mutant clones have been isolated which require exogenous vitamins for optimal growth. One, *M.*336, requires aneurin, responding to concentrations as low as 10^{-10} gm. per c.c. The complete molecule can be replaced by the pyrimidine moiety alone, indicating that the synthetic ability respecting thiazole is unimpaired. Another mutant, *M.*701, requires *para*-aminobenzoic acid, replaceable by aniline at a relative efficiency of the order of 1 per cent. (In this connexion, it may be mentioned that inhibition of wild-type cells by sulphanilamide can be reversed by *para*-aminobenzoic acid, but not by aniline.) *M.*701 has been crossed with wild-type: in the progeny of zygotes analysed, dependence on *para*-aminobenzoic acid appears to behave as a single Mendelian character, showing no linkage with mating-type.

The experimental induction of biochemical mutants in algæ provides a fruitful approach to the study of the comparative physiology of autotrophs, parallel with that now extensively investigated in heterotrophs such as *Neurospora* and *Bacterium coli*.

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[1] Hutner, S. H. (personal communication).
[2] Ondratschek, K., *Arch. Mikrobiologie*, **11**, 89 (1940).
[3] Lwoff, A., *Ann. Rev. Microbiol.*, **1**, 101 (1947).

Mango: its Allopolyploid Nature

The mango, a favourite tropical fruit, which is widely cultivated in India, belongs to the Malaysian genus *Mangifera* Linn. (fam. Anacardiaceæ). Taxonomic study[1] shows that it contains forty-one valid species, three of which, *M. indica* L. (wild and cultivated), *M. sylvatica* Roxb. (wild in the hilly forests of north-east India), and *M. khasiana* Pierre (a species of doubtful occurrence) have been reported from India. About a thousand cultivated varieties of mango occur in India, all of which are included in the single species, *M. indica* L. They differ from one another mainly in fruit characters, on the basis of which they have been classified into three groups: round-, ovate-oblong-, and long-fruited[2]. The morphology of the innumerable varieties shows a gradual, continuous change in their characters, intergrading in range.

Information on the cytogenetics of the species of Anacardiaceæ as a whole is very meagre, especially about *Mangifera* L., only the chromosome number of *M. indica* being known. Maheswari[3] first reported the number doubtfully as $n = 24$–26. Roy[4] reported the haploid number of four varieties as ranging between four and eight. Recently, Janaki Ammal[5] mentioned only the number as $2n = 40$. I have carried out cytogenetical studies on this important genus.

The three species investigated—*M. indica* L. (including twenty-three grafted varieties, and one wild race), *M. sylvatica* Roxb. and *M. caloneura* Kz.

(a Burmese wild species)—show striking stability in their chromosome numbers, all having $n = 20$ and $2n = 40$ chromosomes (Figs. 1 and 2). The chromosomes are 0·4–2·0 μ long, and show minute differences in their size and morphology, on the basis of which they can be separated into eight distinct types. The total number of satellites and secondary constrictions in a complement varies between eight and sixteen, and corresponds generally with the number of nucleoli, as determined by the Feulgen Light-green technique[6]. An analysis of the karyotypes indicates that the varieties of mango and allied species differ mainly in the different assortments of those eight distinct chromosome types; each complement showing slight variation from the other, without any sharp differentiating feature. The phenotypic and the karyotypic characters exhibit an interesting parallelism in the slow, inter-grading, continuous changes in their diagnostic features.

(1) *M. sylvatica*; (2), (3) *M. indica*; (4) *M. caloneura*. (× 2,840)

Pairing and disjunction of the chromosomes in the pollen mother-cell are regular, and twenty bivalents are clearly seen during diakinesis and metaphase (Figs. 3 and 4). No formation of multivalents or any other peculiarity has been observed. During metaphase, the bivalents aggregate in groups of four, three and two due to secondary association. The maximum association of the bivalent groupings is found to be into eight units, which is possibly the basic number for the genus, as is also suggested by the eight distinct chromosome types distinguished on the basis of their morphology. The basic number 8 may also be a derived number from 5, as the allied genera *Rhus* and *Semecarpus* have respectively $2n = 30$ and 60 chromosomes.

These observations, namely, high chromosome number, a correspondingly high number of nucleolar chromosomes, secondary association, regular pairing and disjunction of bivalents, absence of multivalent formation, and good fertility (apparent sterility as determined from pollen analysis is between 1·2 and 12 per cent) establish the allopolyploid origin of the mangoes and allied species. The innumerable varieties have become differentiated from the original type or types primarily through gene mutations, the selected type being preserved under cultivation through vegetative propagation by grafting. The great diversity among mango varieties in India is also to be explained as due to their cultivation for a long period, thereby giving opportunity for hybridization and forces of selection to operate. Selection by man for about four thousand years must have had also an important role in the process.

Thanks are due to Prof. S. P. Agharkar, for his advice and interest in the work, and to Dr. P. N. Bhaduri for help and encouragement. The investigation was carried out with the financial assistance of the Indian Council of Agricultural Research, at the Botanical Laboratory, University of Calcutta.

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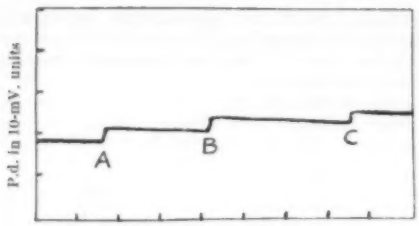
[1] Mukherjee, S. K., *Lloydia*, **12**, 73 (1949).
[2] Mukherjee, S. K., *Bull. Bot. Soc. Bengal*, **2**, 101 (1948).
[3] Maheswari, P., *Curr. Sci.*, **3**, 97 (1934).
[4] Roy, B., *Science and Culture*, **5**, 196 (1939).
[5] Darlington, C. D., and Ammal, E. K. J., "Chromosome Atlas of Cultivated Plants" (1945).
[6] Semmens, C. S., and Bhaduri, P. N., *Stain Tech.*, **14**, 1 (1939).

The Alleged Membrane Potential Produced by Diffusion in Nerve and Muscle Fibres

IN a recent communication in *Nature*, Ling and Gerard[1] state that support for the membrane potential of nerve and muscle being a diffusion potential is afforded by the rectilinear relation between the logarithm of external potassium concentration and the measured membrane potential according to the well-known Nernst equation. For a single fibre of the frog sartorius this value is reported to be 95 millivolts, which is the approximate theoretical value.

These interesting results can also be interpreted in terms of phase-boundary potential in which the solubility of the electrogenic substance in lipoid (not the diffusion) is the important factor. We have repeatedly pointed out[2,3] that the logarithmic relation of the Nernst equation applies to phase-boundary potentials. The logarithm of the concentration of the electrolyte in the aqueous medium bears a rectilinear relation to the potential established by the electrolyte which penetrates and ionizes in the oil layer. No 'membrane' in the sense of Ostwald[4] or Bernstein[5] is necessary, and this logarithmic relation cannot be brought forward as 'proof' or 'support' for the existence of a diffusion potential in a 'membrane'. We know that the exterior of a nerve fibre (where the potential develops) is an interface between oil and aqueous medium. Electron microscopy[6] has failed to reveal the presence of any 'pores' in the nerve 'membrane'.

It seems logical to suppose that the potentials in nerve are phase-boundary potentials set up by organic substances (especially those containing tetra-covalent nitrogen[7], which are electrogenic both in living nerve[8] and in 'test-tube' models consisting of an interface between oil and saline[9]). Accordingly, we have devised models in which tetraethyl onium, acetylcholine and other drugs generate negative phase-boundary potentials in a U-tube of oil immersed in saline (conditions duplicating those at the surface of the living fibre). Under these conditions, simple electrolytes like sodium and potassium[10] have very feeble electrical action, and it is unlikely that they play any part in the production of action currents. The accompanying record shows the failure of potassium chloride to establish appreciable electrical potential at the phase-boundary between an oil (guaiacol) and saline *in vitro*. Ordinates represent electrical potential difference between the two sides of the oil layer; abscissæ show time in increments of 75 sec. each. Reading from left to right, the upward deflexions are produced by the well-known electrical negativity of potassium chloride. At *A*, 500 mgm. of potassium chloride was added to 200 c.c. of saline on one side of the oil-layer, which consisted of guaiacol. At *B*, 1 gm. of potassium chloride was similarly introduced; and at *C*, the massive dose of no less than 2 gm. potassium chloride was placed in the



saline medium, which now contained a total of 3·5 gm. of the potassium salt. (Exp. No. 92 *E*. Temp. 19° C. A Leeds and Northrup Speedomax phase-motor recorder was employed.) It is concluded that potassium has negligible electromotive action in a saline medium (0·85 per cent sodium chloride). In contrast to the effects of sodium and potassium, alkaloids have extraordinary phase-boundary potentials, as we have previously described[2].

In conclusion, it would appear that there is no convincing evidence for the existence of membrane potentials produced by diffusion of potassium or sodium in nerve fibres.

T. Cunliffe Barnes
R. Beutner

Department of Pharmacology,
Hahnemann Medical College and
Hospital of Philadelphia. April 27.

[1] Ling, G., and Gerard, R. W., *Nature*, **165**, 113 (1950).
[2] Beutner, R., and Barnes, T. C., *Biodynamica*, **4**, 47 (1942).
[3] Barnes, T. C., and Beutner, R., *Nature*, **159**, 307 (1947).
[4] Ostwald, W., *Z. phys. Chem.*, **6**, 71 (1890).
[5] Bernstein, J., *Pflüger's Arch.*, **92**, 521 (1902).
[6] Sjostrand, F. S., *Nature*, **165**, 482 (1950).
[7] Lorente de Nó, R., *J. Cell. Comp. Physiol.*, Supp. **33**, 1 (1949).
[8] Brink, F., Bronk, D. W., and Larrabee, M. G., *Ann. N.Y. Acad. Sci.*, **47**, 457 (1946).
[9] Barnes, T. C., *Anat. Rec.*, **99**, 618 (1947).
[10] Barnes, T. C., First International Congress of Biochemistry (Cambridge) Abstracts, 200 (1949).

Helical Fibrillar Structure of Vegetable Fibres

We have seen the comments[1] of Sen and De on our note[2]. It seemed unnecessary to mention that the paired-variate method was used in each case in getting the standard error of the difference, the bundles used for each pair of tests (with *S*- and *Z*-twist) being obtained by dividing a sub-sample into two parts. If the results are examined in the light of this explanation, it will be seen that in the case of the breaking-load the difference between the *S*-twist and *Z*-twist results is highly significant for both samples.

The error in reading turns per inch in the breaking-twist tests was of the order of 0·01 turn per inch in a single observation. The error in reading the diameter of twisted bundles was of the order of 0·007 cm. in a single observation; the magnification of the projected image was 15 diameters, and we could measure the diameter of the image to the nearest millimetre.

As regards torsional rigidity, our remarks were carefully worded. We attribute the small differences to the effects of damping and, possibly, of permanent deformation, which would act differently according to whether *S*- or *Z*-twist was initially applied. Only small differences would be expected, and only small differences are suggested by our results.

Regarding the remarks in the last paragraph of Sen and De's letter, we are aware that our results are a measure of the torque required to produce a twist of one complete turn in unit length of a bundle of fibre-strands.

Our provisional view is that the thick secondary walls are mainly responsible for the effects observed, and that the fibrils of the secondary walls have a small *Z*-twist. The drying and wetting twists of many vegetable fibres are very lively, and it seems likely that the direction of yarn twist has some practical significance. The 'bees'-knees' that form in wet-spun flax yarns after drying are an example. Moreover, a difference of as much as five per cent in the strengths of jute yarns with *S*- and *Z*-twist is quite a possibility.

B. K. Chakrabarti
C. R. Nodder

Indian Central Jute Committee,
Technological Research Laboratories,
Calcutta 33.

[1] *Nature*, **164**, 670 (1949).
[2] *Nature*, **163**, 19 (1949).

A Recent Deposit of Bird Bones in the Falkland Islands

West Point Island lies off the north-west corner of west Falkland and only about a quarter of a mile off-shore. It has been occupied as a small sheep farm for many years, and like everyone else in the Falklands the people of the Island burn peat. The peat-bog, that is the place whence the peat is brought, is situated near the upper end of a valley, roughly one and a half miles long and half a mile wide, which runs up from sea-level at the north to the top of a steep cliff at the south end. The area covered by the peat bog lies at an altitude of approximately 600 ft. It has been worked over by the removal of successive layers of one yard in thickness; in some places three such layers have been extracted, and beneath the lowest, that is, at a depth of nine feet from the original surface, a bone deposit was discovered some fifteen or twenty years ago.

The deposit has been examined at different times by both of us during rather short visits to the Island; but there has been no opportunity to ascertain the horizontal extent of it by excavation. Vertically it is only a few inches thick. One of us (J. E. H.) considered that the bones accumulated in the matrix of the deposit, which is of a clayey nature, prior to the formation of the peat at this site; the other (G. H.-S.) considers that the stratum of clay lies between the peat now being worked and an older peat underneath.

The bones are very plentiful; indeed, in the appropriate layer one cannot insert a spade without cutting through them. They are exclusively avian and include penguin, snipe, finch (*Melanodera* ?) and a carrion hawk—probably *Ibycter australis*. All these birds are still quite common except *Ibycter*, and it was plentiful enough a hundred years ago. The bones themselves are fragile.

The depth at which the bones occur precludes any human agency, and we consider that the peat covers the site of a pond which has now vanished. One may believe that the fresh water proved attractive to the birds, and it seems not unlikely that the mud may have been of such a texture as to entrap the unwary.

G. Hattersley-Smith
J. E. Hamilton

Falkland Islands Dependencies.

FORTHCOMING EVENT

Thursday, August 3

FAUNA PRESERVATION SOCIETY (at the Zoological Society of London, Regent's Park, London, N.W.8), at 4.30 p.m.—General Meeting.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SENIOR ASSISTANT (with a University degree or equivalent, together with industrial and teaching experience) FOR THE RADIO COMMUNICATIONS SECTION of the Department of Electrical Engineering and Applied Physics—The Secretary, South-East London Technical College, Lewisham Way, London, S.E.4 (August 5).

CHEMISTS and CHEMICAL ENGINEERS (Senior Scientific Officer and Scientific Officer grades, unestablished) at a Ministry of Supply Research Establishment near London: (*a*) PHYSICAL CHEMIST with a training in chemical engineering and an aptitude for plant development work, (*b*) CHEMIST with research experience in some branch of physical chemistry, (*c*) PHYSICAL CHEMIST with experience in propellant explosives with, preferably, some knowledge of weapon techniques, (*d*) CHEMIST with plant experience in the liquefaction and purification of gases—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.405/50A (August 7).

GRADUATE ASSISTANT IN BIOCHEMISTRY in the Pathology Department—The Secretary, Queen Elizabeth Group Hospital Management Committee, Hackney Road, London, E.2 (August 7).

SCIENTIFIC OFFICER (Chemist, with a University degree including honours chemistry, preferably with zoology and biology as subsidiary subjects) in the Department of Agriculture for Scotland Food Infestation Control Section in Glasgow—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.271/49A (August 7).

PRINCIPAL SCIENTIFIC OFFICER (Research Engineer) to take charge of development work on food processing in a Ministry of Food experimental factory at Aberdeen—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting C.48/50A (August 8).

SCIENTIFIC OFFICER (with honours degree in chemistry, with postgraduate experience or an honours degree in agricultural chemistry) in the Chemical Research Division of the Ministry of Agriculture—The Director of Establishments, Ministry of Finance, Stormont, Belfast (August 10).

SENIOR and JUNIOR FELLOWSHIPS at a Ministry of Supply Research Establishment in South-west England, for research into specialized aspects of physiology and pharmacology connected with the injurious effects of toxic materials and with methods for their treatment—The Ministry of Supply, Est.3(c)1, Adelphi, Strand, London, W.C.2 (August 10).

EXPERIMENTAL OFFICERS at a Ministry of Supply Experimental Establishment in South-West England: PHYSICISTS (Ref. A.196/50) with a good knowledge of physics and mathematics, preferably to degree standard; ENGINEERS (Ref. C.368/50) with experience in design and development of light engineering machinery; and CHEMISTS (Ref. F.435/50) with a good knowledge of chemistry, preferably to degree standard—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (August 12).

LECTURER IN THE DEPARTMENT OF CHEMISTRY (with a degree or equivalent qualification in chemistry, and a particular interest in physical and/or inorganic chemistry)—The Principal, Derby Technical College, Normanton Road, Derby (August 12).

ASSISTANT LECTURER IN THE DEPARTMENT OF CHEMISTRY (with special qualifications in Organic Chemistry), and a RESEARCH FELLOW IN ORGANIC CHEMISTRY—The Clerk, Birkbeck College, Fetter Lane, London, E.C.4 (August 15).

PERMUTIT COMPANY SENIOR STUDENTSHIPS (2) IN CHEMISTRY, ENGINEERING or CHEMICAL ENGINEERING—The Master, St. Catharine's College, Cambridge (August 15).

RESEARCH FELLOWSHIP IN MATHEMATICAL PHYSICS—The Secretary, The University, Birmingham 3 (August 15).

ENGINEER (Principal Scientific Officer or Senior Scientific Officer grade) (Ref. C.380/50) to control section studying problems of liquid fuel rocket combustion chambers, atomizers, nozzles, etc., a PHYSICIST (Principal Scientific Officer or Senior Scientific Officer grade) (Ref. A.205/50) to study problems relating to rocket motors, and CHEMISTS (Senior Scientific Officer or Scientific Officer grade) (Ref. F.216/50) for research and development work on solid propellant rocket motors, at a Ministry of Supply Research and Development Establishment in the Home Counties—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting the appropriate Ref. No. (August 17).

PLANT PATHOLOGIST at the Forestry Commission Research Station at Alice Holt, Farnham, Surrey, to carry out an investigation into a disease of sycamore trees in Great Britain—The Secretary, Forestry Commission, 25 Savile Row, London, W.1 (August 21).

ASSISTANT LECTURER (with a special degree or its equivalent in botany) IN THE DEPARTMENT OF BOTANY—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (August 25).

PHYSICISTS with honours degree in physics or engineering (Principal Research Officer grade) for wool textile research—The Chief Scientific Liaison Officer, Australian Scientific Liaison Office, Africa House, Kingsway, London, W.C.2 (August 28).

UNIVERSITY LECTURER IN THEORETICAL ELECTRODYNAMICS AND RADIO—Miss J. Bird, Chemical Laboratory, Cambridge (August 30).

I.C.I. FELLOWSHIP IN CHEMISTRY or PHYSICS, or a related subject, tenable at Durham or Newcastle—The Registrar, University Office, 46 North Bailey, Durham (August 31).

LECTURER IN ELECTRICAL ENGINEERING at University College, Dundee—The Secretary, The University, St. Andrews (August 31).

LECTURER (Grade II) IN INDUSTRIAL METALLURGY—The Secretary, The University, Birmingham 3 (August 31).

RESEARCH ASSISTANT IN PHYSIOLOGY—The Nuffield Professor of Industrial Health, King's College, Newcastle-upon-Tyne (August 31).

SENIOR LECTURER IN MICROBIOLOGICAL CHEMISTRY at the University of Melbourne—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (August 31).

STUDENTSHIP IN PHYSICAL CHEMISTRY, with special reference to photochemistry and spectroscopy—The Secretary, Department of Physical Chemistry, Free School Lane, Cambridge (August 31).

CHAIR OF MICROBIOLOGY in the University of Otago, Dunedin, New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (September 1).

RESEARCH FELLOW (Physical Chemist willing to develop radio isotope technique) IN THE SCHOOL OF METALLURGICAL RESEARCH, University of Melbourne—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (September 1).

UNIVERSITY LECTURER or UNIVERSITY DEMONSTRATOR IN THE ENGINEERING DEPARTMENT—The Secretary, Appointments Committee, Engineering Laboratory, Cambridge (September 2).

CHAIR IN METALLURGY—The Registrar, The University, Sheffield (September 4).

LECTURERS (2) IN THE DEPARTMENT OF MINING ENGINEERING, University of Queensland—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (September 15).

STUDENTSHIP for fundamental research in some field which may be relevant to the food industries of Northern Ireland—The Secretary, Queen's University, Belfast (September 21).

ASSISTANT DIRECTOR IN THE COMMONWEALTH BUREAU OF PASTURES AND FIELD CROPS, Aberystwyth—The Secretary, Commonwealth Agricultural Bureaux, 2 Queen Anne's Gate Buildings, London, S.W.1 (October 1).

SENIOR LECTURER IN CHEMICAL PATHOLOGY—The Dean of the Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1 (October 1).

APPLIED MATHEMATICIANS in the Technical Section, (*a*) a SENIOR MATHEMATICIAN to direct a small mathematical sub-section undertaking varied and, to some extent, unpredictable work, including the study of economical employment of novel processes, stability of complex plant operation, problems in air and gas dynamics, etc., and (*b*) a MATHEMATICIAN to assist with this work—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs.

ASSISTANT BIOCHEMIST—The Administrative Officer, City Hospital, Nottingham.

BIOCHEMIST or CHEMIST, for research on fundamental problems related to the nervous system—The Director, Neuropsychiatric Research Centre, Whitchurch Hospital, Cardiff.

CHEMIST or BIOCHEMIST, to study metal-organic complexes in relation to nutrition—The Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire.

CHEMIST (with a good University degree in chemistry and Associateship of the R.I.C., and experience in biochemistry and pathology as related to crime) in the Medical Department, Gold Coast—The Director of Recruitment, Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting No. 27106/10/49.

DEMONSTRATOR IN PHARMACY—The Registrar, The University, Nottingham.

GRADUATES (3) with first- or second-class honours in physical chemistry or physics, for fundamental work on combustion of solid fuels—The Assistant Secretary, British Coal Utilization Research Association, Randalls Road, Leatherhead, Surrey.

INDUSTRIAL RESEARCH CHEMIST (with an honours degree in chemistry and experience in managing an industrial research department) to take charge of the Applied Research Laboratories in the Ministry of Supply Division of Atomic Energy (Production) at Seascale, Cumberland—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs.

LECTURER IN CHEMISTRY, to teach to Intermediate and Final B.Sc. Degree standard—The Clerk, Northern Polytechnic, Holloway Road, London, N.7.

LECTURER IN THE DEPARTMENT OF CHEMISTRY, with special qualifications in inorganic and/or physical chemistry—The Secretary, Royal Technical College, Glasgow.

LECTURER (with honours degree in mathematics) IN THE DEPARTMENT OF PURE AND APPLIED SCIENCE—The Registrar, Loughborough College, Loughborough, Leics.

METEOROLOGISTS in the Sudan Government Meteorological Service—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Meteorologist'.

PHYSICISTS or PHYSICAL CHEMISTS for (*a*) general investigations on the physics of felt making, and (*b*) investigations on the physics and physico-chemical properties of emulsions of shellac in alkali and their absorption and adsorption by felts—The Director, British Hat and Allied Feltmakers Research Association, Stanley House, Manchester Road, Fairfield, Droylsden, Manchester.

PROFESSOR OF PHYSICS, a LECTURER IN MATHEMATICS, and a LECTURER IN GEOGRAPHY, at the College of Arts and Science, Baghdad—The Cultural Attaché, Iraqi Embassy, 22 Queen's Gate, London, S.W.7.

SENIOR ASSISTANT IN CIVIL ENGINEERING in the Building Department, and an ASSISTANT IN BIOLOGY in the Department of Applied Science, Wolverhampton and Staffordshire Technical College—The Clerk to the Joint Education Committee, Education Offices, North Street, Wolverhampton.

SOIL PHYSICIST in the Department of Agriculture, Sierra Leone, for investigations in connexion with the reclamation, drainage and cultivation of paddy rice on very acid soil—The Director of Recruitment, Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Provisions of the Pharmacy and Poisons Act 1933 and Poisons Rules 1949 relating to Sales of Insecticides, Fungicides, Weedkillers, Rodenticides, etc. Chart (17 in. × 23 in.) in booklet form. (London: Association of British Insecticide Manufacturers, 1949.) 1*s*. [255

The First 25 Years. Pp. 24. (Goole: Croda, Ltd., 1950.) [255

Council for the Preservation of Rural England. Annual Report, 1949–50. Pp. 56. (London: Council for the Preservation of Rural England, 1950.) [16

Department of Agriculture: Fisheries Branch. Report on the Sea and Inland Fisheries for the Year 1948. (P. No. 9747.) Pp. 29. (Dublin: Stationery Office, 1950.) 1*s*. [16

Council for the Preservation of Rural Wales. Annual Report, 1949–50. Pp. 36. (Aberystwyth and London: Council for the Preservation of Rural Wales, 1950.) [16

Annual Report of the Royal Zoological Society of Scotland for the Year ending 31st March 1950. Pp. 16. (Edinburgh: Royal Zoological Society of Scotland, 1950.) [16

British Museum (Natural History). Economic Series No. 1: The House-Fly as a Danger to Health; its Life-History and How to Deal with It. Fifth edition. Pp. v+17. (London: British Museum (Natural History), 1950.) 6*d*. [16

British Standard 1582: 1950, Technical Compound Cod Oil. Pp. 16. (London: British Standards Institution, 1950.) 2*s*. 6*d*. net. [16

The Colonial Territories (1949–50). (Cmd. 7958.) Pp. viii+158. (London: H.M. Stationery Office, 1950.) 4*s*. net. [26

British Journal for the Philosophy of Science. (Quarterly.) Vol. 1, No. 1, May. Pp. iv+76. (Edinburgh and London: Thomas Nelson and Sons, Ltd., 1950.) 7*s*. 6*d*.; annual subscription, 30*s*. [56

Royal Anthropological Institute. Report of the Council for the Session July 1949 to June 1950. Pp. 22. (London: Royal Anthropological Institute, 1950.) [56

Early Days of Genetics. By R. C. Punnett. (Reprinted from *Heredity*, Vol. 4, Part 1.) Pp. 10. (Edinburgh and London: Oliver and Boyd, Ltd., 1950.) 2*s*. 6*d*. net. [56

Quarrying in the Peak District National Park. By Edgar Morton. Pp. 12. (Sheffield: Joint Committee for the Peak District National Park, 1950.) 1*s*. [66

John Innes Leaflet No. 10: The John Innes Glasshouses, Bayfordbury, Hertford. Pp. 12+2 plates. (Edinburgh and London: Oliver and Boyd, Ltd., 1950.) 1*s*. net. [66

Commonwealth Bureau of Plant Breeding and Genetics. Technical Communication No. 15: Field Trials, 2, The Analysis of Covariance. By Dr. John Wishart. Pp. 35. (Cambridge: School of Agriculture, 1950.) 3*s*. 6*d*. [96

National Parks and Access to the Countryside. Pp. 16+7 plates. (London: H.M. Stationery Office, 1950.) 6*d*. net. [96

British Drug Houses, Ltd. Report and Accounts, 1949. Pp. 12. (London: British Drug Houses, Ltd., 1950.) [96

Royal Commission for the Exhibition of 1851. Reports of the Board of Management and Science Scholarships Committee. Pp. 20. (London: Royal Commission for the Exhibition of 1851, 1950.) [96

A Century of Public Libraries, 1850–1950. Pp. 28. (London: Library Association, 1950.) 6*d*. [96

Annual Report and Transactions of the Yorkshire Philosophical Society for the Year 1948–49. Pp. 8. (York: Yorkshire Philosophical Society, 1950.) [96

Philosophical Transactions of the Royal Society of London, Series A: Mathematical and Physical Sciences. No. 850, Vol. 242: Relaxation Methods applied to Engineering Problems, 14, Plastic Straining in Two-dimensional Stress-Systems. By D. N. de G. Allen and Sir Richard Southwell. Pp. 379–414. 8*s*. No. 851, Vol. 242: The Determination of Gaseous Densities. By B. Lambert and C. S. G. Phillips. Pp. 415–438. 5*s*. 6*d*. (London: Cambridge University Press, 1950.) [136

World Refrigeration. (Monthly.) Vol. 1, No. 1, June. Pp. 40. (London: World Refrigeration, 1950.) 2*s*. 6*d*.; annual subscription, 25*s*. [136

City of Leeds. Annual Report of the Sub-Libraries and Arts (Museums) Committee to the Council for the Year ended 31st March 1950. Pp. 8. (Leeds: City Museum, 1950.) [136

Council for the Preservation of Rural England, Sheffield and Peak District Branch. Annual Report, May 1950. Pp. 24. (Sheffield: Council for the Preservation of Rural England, Sheffield and Peak District Branch, 1950.) [136

University of Cambridge: School of Agriculture. Agricultural Periodicals of the British Isles, 1681–1900, and their Location. Compiled by F. A. Buttress. Pp. 16. (Cambridge: School of Agriculture, 1950.) 2*s*. [136

Other Countries

World Health Organization. Technical Report Series. No. 1: Expert Committee on the Unification of Pharmacopœias; Report on the Fourth Session. Pp. 16. 9*d*.; 10 cents. No. 2: Expert Committee on Biological Standardization; Report on the Third Session. Pp. 18. 1*s*. 6*d*.; 20 cents. No. 3: Expert Committee on Biological Standardization; Report of the Sub-Committee on Fat-Soluble Vitamins. Pp. 10. 9*d*.; 10 cents. No. 5: Expert Committee on Health Statistics; Report on the First Session. Pp. 10. 9*d*.; 10 cents. No. 6: Active Immunization against Common Communicable Diseases of Childhood; Report of a Group of Consultants convened by the Director-General. Pp. 18. 1*s*. 3*d*.; 15 cents. No. 7: Expert Committee on Tuberculosis; Report on the Fourth Session. Pp. 20. 1*s*. 3*d*.; 15 cents. No. 9: Expert Committee on Mental Health; Report on the First Session. Pp. 42. 2*s*. 3*d*.; 30 cents. No. 10: Expert Committee on Environmental Sanitation; Report on the First Session. Pp. 34. 2*s*.; 25 cents. No. 12: Expert Committee on the Unification of Pharmacopœias: Report on the Fifth Session. Pp. 12. 9*d*.; 10 cents. No. 13: Expert Committee on Venereal Infections; Report on the Third Session. Pp. 28. 1*s*. 6*d*.; 20 cents. No. 14: Expert Committee on Venereal Infections; Report on the First Session of the Sub-Committee on Serology and Laboratory Aspects. Pp. 40. 2*s*.; 25 cents. No. 15: Venereal-Disease Control in the U.S.A.; Report of the WHO Syphilis Study Commission. Pp. 70. 3*s*. 6*d*.; 45 cents. No. 21: Expert Committee on Drugs liable to Produce Addiction; Report on the Second Session. Pp. 14. 9*d*.; 10 cents. (Geneva: World Health Organization, 1950.) [16

Institut pour l'Encouragement de la Recherche scientifique dans l'Industrie et l'Agriculture. Rapport annuel, 1949. Pp. 165. (Bruxelles: Institut pour l'Encouragement de la Recherche scientifique dans l'Industrie de l'Agriculture, 1949.) [16

Gold Coast Colony. Report on the Forestry Department for the Year 1948–49. Pp. 22. (Accra: Government Printing Department; London: Crown Agents for the Colonies, 1949.) 2*s*. [16

Fouad I University. Publications of the Marine Biological Station, Ghardaqa, No. 7: The External Features in the Development of the Rhinobatidæ. By Dr. M. A. Melouk. Pp. 98+11 plates. (Cairo: Fouad I University Press, 1949.) [16

Ministry of Agriculture, Egypt: Spinning Test Mill at Giza. Technical Bulletin No. 253: Frequency of Neps in Yarns of Egyptian Cottons. By Osman Mohammed Abdelhafez. Pp. 8+8 plates. (Cairo: Government Press, 1950.) P.T. 16. [16

Department of Agriculture, Canada. Annual Report of the Forest Insect Survey—Forest Insect Investigations, 1949. Pp. 122. (Ottawa: King's Printer, 1950.) [16

Beach Erosion Board: Corps of Engineers. Technical Memorandum No. 14: Report on Beach Study in the Vicinity of Mugu Lagoon, California. Pp. v+47. Technical Memorandum No. 15: Longshore-Bars and Longshore-Troughs. Pp. v+32. (Washington, D.C.: Government Printing Office, 1950.) [16

Bulletin of the American Museum of Natural History. Vol. 95, Article 2: The Phylogeny of Termite Genera based on Imago-Worker Mandibles. By Muzaffer Ahmad. Pp. 37–86. (New York: American Museum of Natural History, 1950.) 60 cents. [16

Transvaal Museum. Memoir No. 4: Part 1, Further Evidence of the Structure of the Sterkfontein Ape-Man *Plesianthropus*, by Robert Broom and J. T. Robinson; Part 2, The Brain Casts of the recently discovered *Plesianthropus* Skulls, by Dr. G. W. H. Schepers. Pp. 117+8 plates. (Pretoria: Transvaal Museum, 1950.) [16

Technical Publications, 1947. Pp. xi+499. (New York: Standard Oil Development Co.; London: Esso Development Co., Ltd., 1950.) [16

Coryndon Memorial Museum. Annual Report for 1949. Pp. 21. (Nairobi: Coryndon Memorial Museum, 1950.) 1*s*. [56

South African Council for Scientific and Industrial Research: National Building Research Institute. Series DR2: The Properties of Compacted Soil and Soil-Cement Mixtures for use in Building. By T. L. Webb, T. F. Cilliers and N. Stutterheim. Pp. 62. (Pretoria: South African Council for Scientific and Industrial Research, 1950.) [56

Amsterdam Naturalist. (Bulletin of the Zoological Museum, Amsterdam.) (Monthly.) Vol. 1, No. 1, April. Pp. 34+12 plates. (Amsterdam: 'De Regenboog' Publishers, 1950.) Subscription to Vol. 1, 8 f.; 16*s*. [56

Companhia de Diamantes de Angola. Museo do Dundo: Subsidios para o estudo da biologia na Lunda. Sobre uma nova espécie de *Hoplitocoris* (Enicocephalidae, Hemiptera) de Angola. Por Petr Wyzodzinsky. Pp. 8. Remarques sur les Scorpions de l'Angola. Première note. Par Max Vachon. Pp. 18. Insecta Thysanura hucusque in Lunda reperta. A Prof. F. Silvestri. Pp. 30. Protoures de l'Angola. Première note. Par B. Condé. Pp. 12. Deux larves saproxylophyles de Coléoptères de l'Angola. Par Renaud Paulian. Pp. 12. A Collection of Opiliones and Scorpions from North-East Angola made by Dr. A. de Barros Machado in 1948. By R. F. Lawrence. Pp. 20. New Species and Genus of Apterous Aradidæ (Hemiptera–Heteroptera) from Angola. By Ludvik Hoberlandt. Pp. 9. Reptiles et Batraciens de la region de Dundo, Première note. Par R. Laurent. Pp. 17. Nouvelles espèces de *Chrysolina*, subg. Naluhia (Coleoptera, Chrysomelidæ) de l'Afrique équatoriale. Par Jan Bechyné. Pp. 11. (Lisboa: Companhia de Diamantes de Angola, 1948–1950.) [66

Companhia de Diamantes de Angola. Museo do Dundo: Subsidios para a historia, arqueologia e etnografia dos povos da Lunda. Some String Figures from North East Angola. By M. D. and L. S. B. Leakey. Pp. 24. Publicacoes culturais, No. 1: Stations préhistoriques de l'Angola du Nord-Est; Analyse géologique, climatologique et préhistorique d'un sondage fait en bordure de la rivière Luemba. Por J. Janmart. 2ª edicao. Pp. 87. Publicacoes culturais No. 2: La station préhistorique de Candala (District de la Lunda, Angola du Nord-Est) e outros estudos sobre prè-história da Lunda, por Jan Janmart; As gravuras rupestres do Alto-Zambeze e primeira tentativa da sua interpretacao, por José Redinha. Pp. 92. Publicacoes culturais No. 3: Contribuicao para o estudo de alguns caracteres Dentários dos Indigenas da Lunda, por Reinaldo de Almeida; Grupos sanguineos dos Indigenas da Lunda e Songo, por J. H. Dos Santos David. Pp. 71. (Lisboa: Companhia de Diamantes de Angola, 1947–1949.) [66

Catalogues

The Microid Flask Shaker. (GT. 1351.) Pp. 2. G and T Thermostatic Oven. (GT. 1367.) Pp. 2. Microid Polishing Aluminas. (GT. 1386.) Pp. 4. The G and T Universal Laboratory Stirrer. (GT. 1388.) Pp. 2. Stanton Balances and Weights. (GT. 1390.) Pp. 6. Pyrex ⅛ in. Glass Pipe Lines. Pp. 4. (London: Griffin and Tatlock, Ltd., 1950.)

Old Science and Medicine. (Catalogue 90.) Pp. 52. (London: E. P. Goldschmidt and Co., 1950.)

The Service Microscope. Pp. 16. Binocular Microscopes. Pp. 16. (London: W. Watson and Sons, Ltd., 1950.)

Early Works on Medicine and Science. (No. 679.) Pp. 52. (London: Bernard Quaritch, Ltd., 1950.)

Astronomie, Météorologie, Mathématiques, Microscopie, Photographie, Aviation, Orographie. (Catalogue No. 53.) Pp. 16. (Bruxelles: Libr. Victor Hankard, 1950.)

Muirhead Technique. Vol. 4, No. 2, April. Pp. 9–16. (Beckenham: Muirhead and Co., Ltd., 1950.)

Teddington Type QY Pressure Control. Pp. 4. (Sunbury: The British Thermostat Co., Ltd., 1950.)